CHAPTER ONE

INTRODUCTION

1.1 Introduction

Breast masses have become common in women. Such masses may pose a potential threat to women especially when it belongs to breast cancer. Breast cancer is one of the leading causes of cancer deaths in women worldwide.

The early diagnosis and management of breast masses is therefore important to reduce mortality. The established management of palpable breast lesions includes the triple assessment of physical examination, mammography and percutaneous biopsy (TabarandPentek 1981).

Mammography, althoughinvaluable in a screening role, is not 'specific' enough formaking a definitive preoperative diagnosis (Burn, 1978).The appearance of breast masses on mammography is often non diagnostic. In addition, some clinically palpable masses may be poorly defined or not visualized at all on the mammogram which often requires a biopsy to rule out malignancy. The accurate diagnosis of breast lesions without resort to formal biopsy is highly desirable both for patients who can be quickly reassured or counselled and the clinician who can reduce unnecessary surgery (Smallwood et al.1984) .Additionally, the cost of biopsies is also high and a large number of biopsies for benign breast abnormalities have been recognized as a serious problem since excessive biopsies have adverse effects on women who undergo them (Howard ,1990) ,Therefore Ultrasound is an important safe imaging modality in the assessment of palpable breast masses.

The use of ultrasound to examine the breast was first described in 1951(Jackson, 1990). Since then, the ultrasound examination is well established as an important technique for the investigation of breast problems.

Ultrasound has become popular even in lower level health centers of developing countries. For example, in Uganda ultrasound services have become available in lower health facilities due to her decentralized health care system (Mubuuke et al.2009). At the same time, there are many training institutions training radiologists, sonographers carry out the ultrasound examinations as primary investigation.

It is evident therefore that the accuracy of ultrasound in evaluating breast masses and differentiate benign from malignant breast lesions needs to be documented since many clinicians are requesting for it in assessing the breast masses.

1.2 Problem Statement

Palpable solid breast masses now are a common disease, so biopsies are performed routinely on solid breast lesion identified clinically or on mammogram. The accurate diagnosis of the breast without resort to formal biopsies is highly desirable. Ultrasound could possibly provide clear criteria for determining benign and malignant lesion when it is considered as reliable accurate examination modality in detecting palpable solid breast mass.

1.3 Research Objective

1.3.1 General objective

- ❖ The main purpose of this study is to determine the accuracy of ultrasound in diagnosing palpable solid breast masses.

1.3.2 Specific:

- To compare and correlate the ultrasound finding with biopsy results.

- To analyze and study the value of various sonography features in differentiation benign from malignant breast tumors to improve diagnostic accuracy of ultrasound in detecting solid masses.These features are :
  - Size
  - Orientation
  - Shape (round ,oval, irregular)
  - Echo density (hypo echoic, hyper echoic ,isochoric)
  - Echo pattern (homogenous or inhomogeneous)
  - Posterior acoustic properties (posterior wall enhancement or acoustic shadow)
  - Architecture of surrounding tissue
  - Vascularity.

- To determine the validity of ultrasound in the assessment of the palpable breast mass by determining the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasound in distinguishing a malignant mass.

- To formulate the most discriminating ultrasound characteristics for differentiating benign and malignant masses.

CHAPTER TWO

LITERATURE REVIEW

2.1Anatomy Of The Breast

2.1.1 Breast Parenchyma & Structure

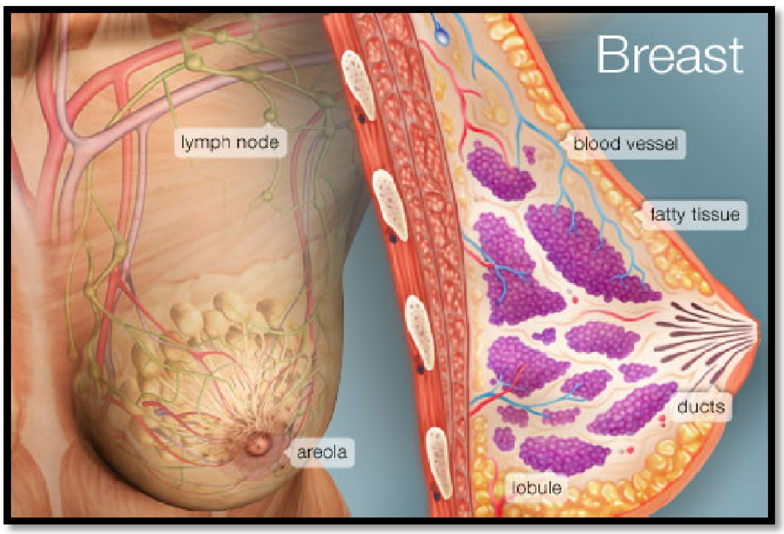

Figure 2.1. Anatomy of the breast(Moore ,2010)

Histologically, breasts consist of glandular tissue, fibrous tissue and fatty tissue. The glandular tissue is arranged predominantly on the upper outer quadrant of the breast. The glandular tissue consists of fifteen to twenty lobes, where each lobe divided into numerous lobules. Each lobule then consists of alveoli which are the sites of milk secretion. Around the areola, the lactiferous ducts have dilated areas called lactiferous sinuses where the accumulation of milk occurs during lactations. The lactiferous ducts all open at the nipple.

The fibrous connective tissue of the breast separates the lobes from one another and also forms the suspensory (Cooper's) ligaments which extend from the underlying muscle to the skin and provide natural support for the breast.

The fatty tissue of the breast covers theglandular surface and lies between the lobes. Most of the breast size is due to fat deposits, whereas the superficial fat gives the breast its shape (Marieb, 1989).

2.1.2 Breast blood supply

The blood supply to the breast is derived from three sources. The predominant supply of blood comes from the perforating branches of the internal mammary arteries, derived from the internal thoracic artery. The breast is further supplied by the lateral thoracic and thoracic acromial arteries (branches of the axillary artery) as well as posterior intercostal arteries (branches of the thoracic aorta).

Venous drainage of the breast is mainly accomplished by the axillary vein. The subclavian, intercostal, and internal thoracic veins also aid in returning blood to the heart. (http://fitsweb.uchc.edu)

2.1.3 Lymphatic drainage of the breast

Lymphatic drainage of breast originates from breast lobules and flow into a sub-areolar plexus, called Sappey's plexus. From this plexus, lymphatic drainage takes place through three main routes:

First:Axillary or lateral pathway: This pathway runs around the inferior edge of the pectorals major and reach the pectoral group of axillary nodes.

Second: Internal mammary pathway: This pathway originates from both the lateral and medial halves of the breast and passes through the pectorals major; connections may lead across the median plane and hence to the contralateral breast.

Third: Retro mammary pathway: This pathway comes from the posterior portion of the breast .Lymphatics may reach the sheath of the rectus abdominis and the subperitoneal and subhepatic plexuses.

Usually axillary lymph nodes receive more than 75% of the lymph drained from the breast. (O'Rahilly and Müller 1983).

2.1.4 Innervation of the breast

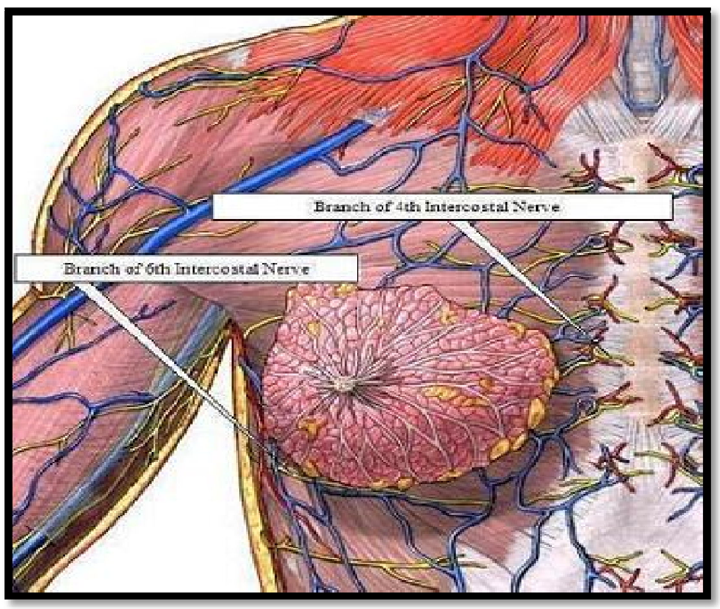

Figure 2.2. Innervation of the breast

From:www.mybreast.org.

The innervation of the breast is supplied mainly by branches of the 4th through 6th intercostal nerves, which convey sensation to the skin of the breast and sympathetic to the blood vessels and smooth muscle cells in the overlying skin andnipple. Although not intimately involved with the innervation of the breast, the long thoracic, thoracodorsal, and intercostalbrachial nerves are important to visualize as they cross through the anatomic spaces of the breast and axilla, and are thus important to consider during dissection. (http://fitsweb.uchc.edu).

2.1.5 Musculature related to the breast

The breast lies over the musculature that encases the chest wall. The muscles involved include pectoral major which is a broad muscle that extends from its origin on the medial clavicle and lateral sternum to its insertion on the humerus**,** serratus anterior that runs along the anterolateral chest wall and rectus abdominis which demarcates the inferior border of the breast. (Hill, 1996:323).

2.1.6 Breast physiology

In order to produce milk, hormones are needed. The two main hormones are prolactin and oxytocin. Prolactin which acts on the human breast to produce milk. This occurs by binding to mammary epithelial cell receptors, which stimulates synthesis of mRNA of milk proteins. It takes several minutes of the infant sucking at the breast to cause prolactin secretion. Prolactin is also important in inhibiting ovulation. Suckling at the breast stimulates the neurohypothesis to produce and release oxytocin in an intermittent manner. Oxytocin acts on the breast to produce milk ejection or "milk let down. (Lawrence, 2011). Newton(1948) showed that women who received a saline injection and were distracted during breastfeeding produced less milk than women who were not distracted or women who received an injection of Pitocin (synthetic oxytocin) prior to distraction and breastfeeding. Lack of release of oxytocin inhibits the "milk let down" and the milk cannot be removed from the breast (Neville, 2001).

Other hormones necessary for the production of breast milk include: insulin, cortisol, thyroid hormone, parathyroid hormone, parathyroid hormone-related protein, and human growth hormone.

2.1.7 Breast changes with age

Breast tissue of young women mostly consists of the glandular tissue and hardly any of fat tissue. As a woman ages, the glandular component is replaced by fat, and the breast becomes softer and hangs lower, as the suspensory ligaments inside the breast stretch. Breast of young multiparous women who breasts feed the babies, are predominantly fatty and even in young girls a certain percent of the breasts may consists of fat, especially in larger breasts. As the breast ages , the mild –producing sacs (lobules) may dilate with fluid and lead to the information of breast cysts, which sometimes enlarge sufficiently to be feltas lumps. Conversely, the breasts of older woman who are on hormone replacement therapy will increase in fibro-glandular density (Marugg, 1997).

With the menopause there is reduction in stimulation by the hormone estrogen to all tissue of the body, including breast tissue;this result in reduction in the glandular tissues of the breast. The increase in fat content makes the older breast more lucent to x-ray and easier to compress, so the clarify of the mammographic picture is greater in older woman, making a small tumor more visible. This fact explains the greater accuracy of mammograms in older women and the adoption of population mammographic screening in women over forty years of age(www.accessmedicine.net).

2.1.8Sonographic Anatomy of The Breast:

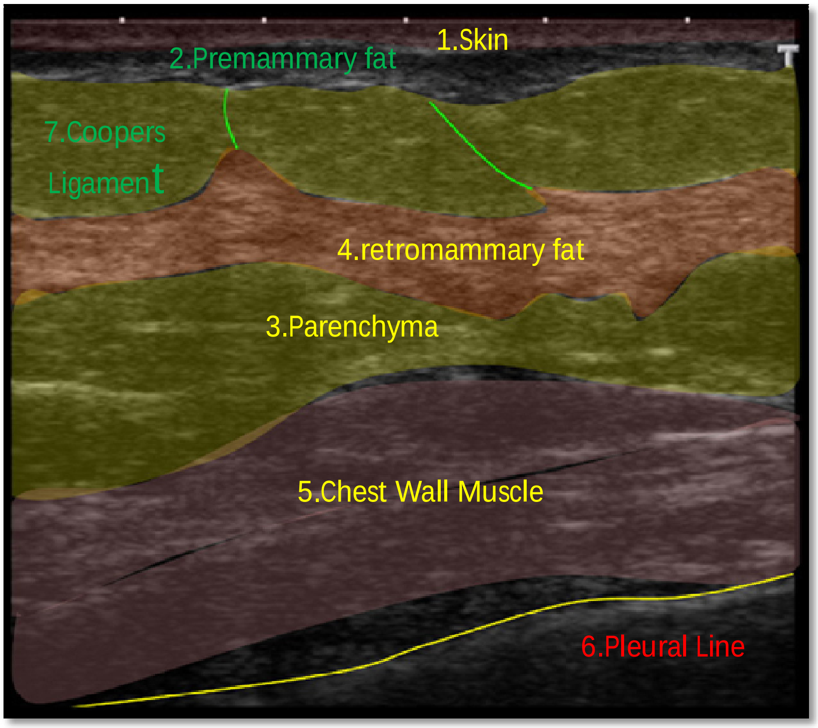

Figure 2.3. Sonographic anatomy of the breast

From: Personal collection

The subcutaneous layer is the most anterior layer bordered anteriorly by the echogenic skin line and posteriorly by the mammography layer. In between, the subcutaneous fat lobules appear as low-level echoes with hyper echoic margins. The mammary layers have a mixed parenchymal appearance depending on the amount of fat that is present. The sonographic appearance with the presence of a small amount of fat is highly echogenic due to the reflection appearance of the existing connective tissue. When more fat is present, the appearance changes to areas of low –level echoes mixed with areas of high echogenicity. The ducts appear as small anechoic branches running throughout the layer (Marieb, 1989).

2.2Mass Characteristic

2.2.1 Characteristics of the solid nodules

With the experience acquired through the daily practice, results from a previous study, and a literature review, the characteristics have been utilized and described by the majority of authors in this rating methodology as follows:

a.The Shape:

The shape may be well-defined (rounded (A), oval-shaped, elongated) or ill-defined (; limits may be precise (clear), imprecise (unclear) or partially precise.

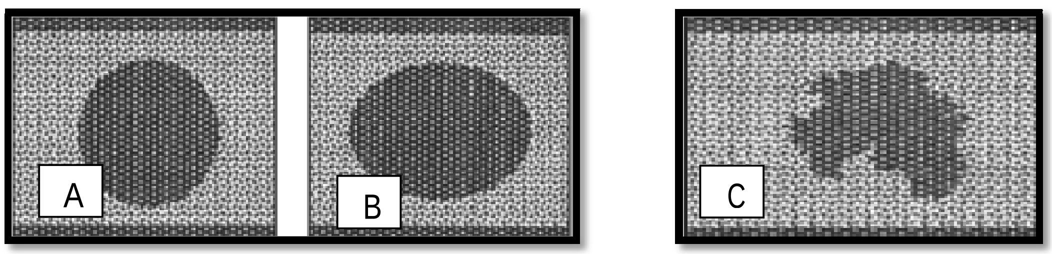

Figure 2.4. Shape of the lesion (round (A), oval (B) and irregular (C)

b.Margin:

The contour or margins may be regular, partially regular (macrolobularaspect (A) or irregular (angular, microlobular, speculated or indistinct aspect (B).

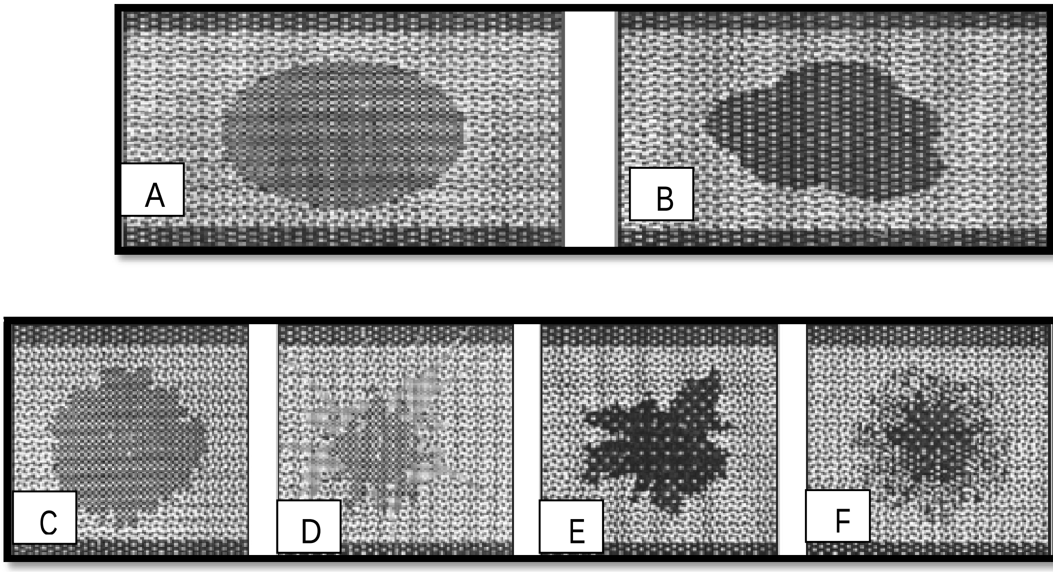

Figure 2.5 Margin of the lesion: regular (A), macrolobular (B), irregular with microlobular (C), speculated (D), angular (E) and indistinct (F).

c.Echogenicity

The echogenicity is defined by comparison between images and the surrounding fibro-adipose tissue, and may be anechoic, hypo echoic, isoechoic, hyperechoic and mixed (for example, anechoic and hypoechoic, or hypoechoic and hyperechoic).

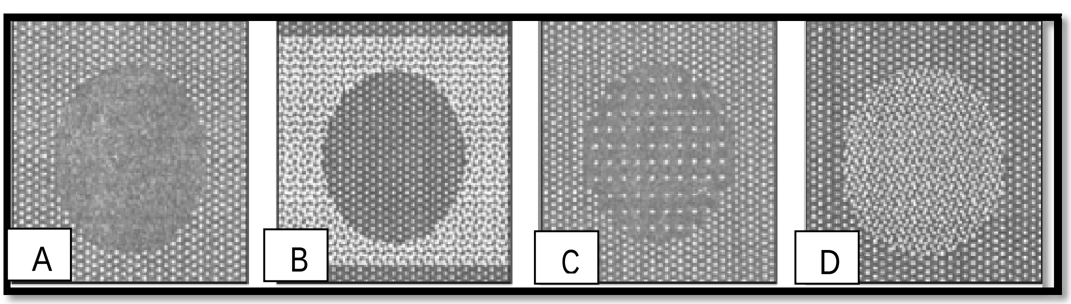

Figure 2.6 Echogenicity: anechoic (A), hypoechoic (B), isoechoic (C) and hyperechoic (D)

d. Echotexture

The echotexture is defined as homogeneous or heterogeneous

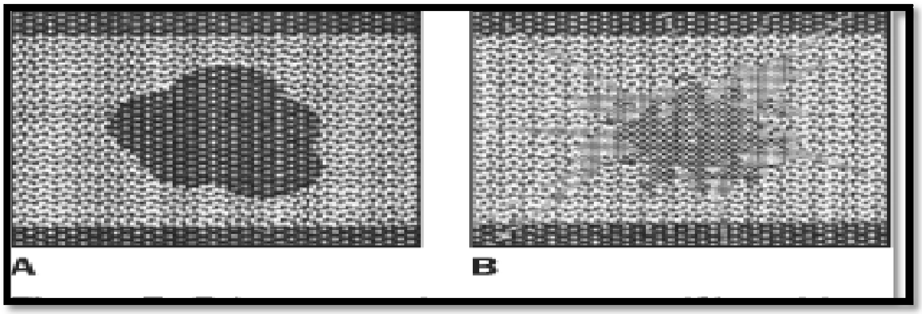

Figure 2.7.Echotexture: homogeneous (A) and heterogeneous (B).

e. Echo transmission

Echo transmission may be absent, present acoustic enhancement or posterior shadow

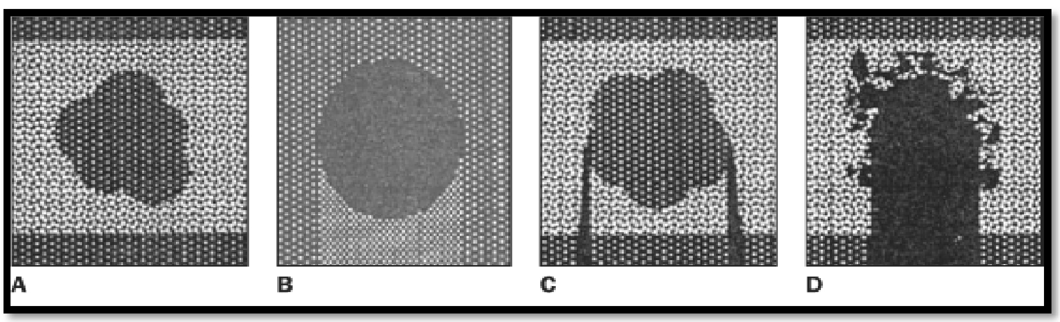

Figure 2.8.Echo transmission: absent (A), acoustic enhancement (B), bilateral acoustic shadowing (C), and central acoustic shadow (D)

f. Orientation

The orientation is defined as horizontal or vertical.

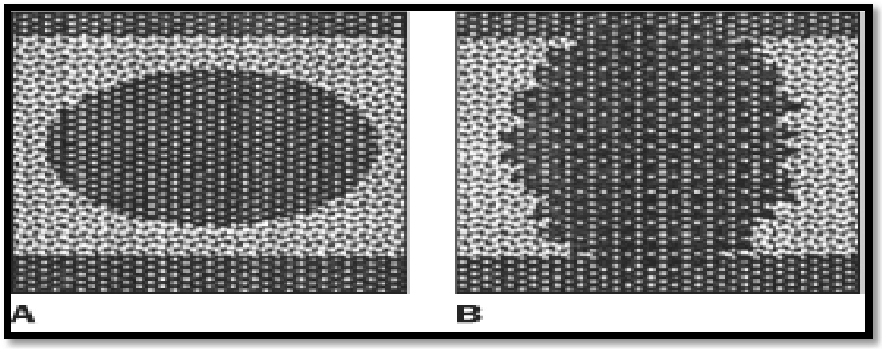

Figure 2.9. Orientation: horizontal (A) and vertical (B)

Besides these fore mentioned characteristics, the following secondary signs are taken into consideration: thickening and/or skin retraction; increase in echogenicity of the subcutaneous, parenchymal cellular tissues; thickening of Cooper ligaments; intra tumor calcifications; parenchymal architectural distortion; muscular and lymph nodes involvement.

2.2.2 Characteristic of benign Solid nodule versus malignant

Table 2.1: Lesion characteristics: benign versus malignant

Shape	Regular	Irregular
Orientation	Parallel to skin	AP diameter greater than width
Margin	Circumscribed	Indistinct
		Ill-defined
		Angular
		Speculated
	Fewer than 4 lobulation	Microlobulation
Echopattern	Homogeneous	Inhomogeneous
Echodensity	Isoechoic	Hypoechoic
	Hyperechoic	
	Anechoic	
Acoustic transmission	Posterior wall enhancement	Acoustic shadowing
Mobility	Mobile	Fixed
Architecture of surrounding tissue	Not Infiltrated	Infiltrated
Vascularity	On the periphery of nodule	On the inside of nodule

2.3. Benign Breast Disease:

2.3.1 Simple cyst

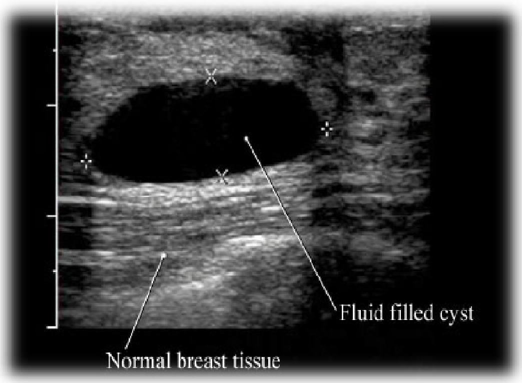

Figure: 2.10 Simple cysts

From: www.ultrasound-image.com

It is a fluid-filled sac within the breast consists of two layers, an inner is epithelial and the outer is myoepithelial.It can be Single or multiple.Sonography, homogenous round or oval lumps with distinct edges,anechoic , well circumscribed and have posterior enhancement. Its height should not exceed its width(Heywang et al, 2001)

2.3.2 Complicated & Complex cyst

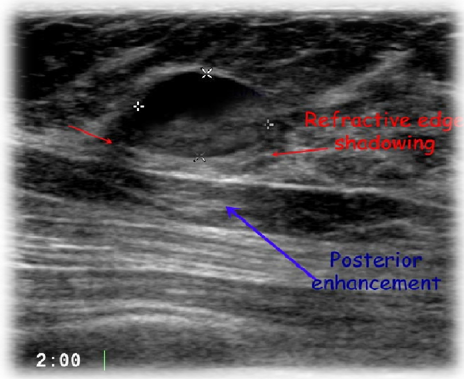

Figure 2.11 Complex cyst

From: www.ultrasound-image.com

Sonography, it is heterogeneous, well circumscribed, enhanced through transmission, has thick septa, and internal blood flow. It contains echogenic fluid, fluid-debris (Heywanget al, 2001).

2.3.3 Galactoceles

Figure: 2.12galactocele

From: www.ultrasound- imaing.com

Galactoceles are milk-filled cystic structures which develop during lactation pregnancy. It is located in the central portion of the breast or under the nipple.Sonography like cyst (single or multiple,anechoic or hypo echoic and has good distal enhancement (Heywanget al, 2001).

2.3.4 Mammary duct ectasia

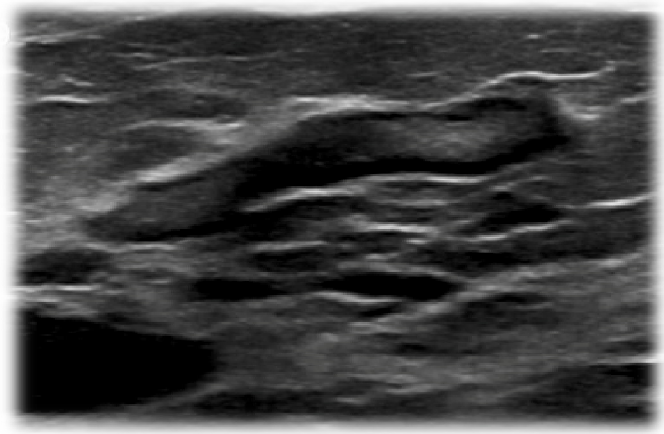

Figure 2.13. Ductectasia

From: personal collection

Mammary duct ectasia is common in women over 50. It occurs when a breast duct widens and its walls thicken, which can cause it to become blocked and lead to fluid build-up irritated.(Heywang et al, 2001).

2.3.5 Fibrocystic disease(Fibroadenosis)

More than 90% of palpable breast masses in women in their 20's to early 50's. Benign Fibrocystic breast disease - also called fibroadenosis– which is a common non-cancerous breast condition. More than half of all women have fibrocystic breasts at some point.Sonographyhypo echoic, lobulated, well defined mass in the breast. A few anechoic spaces (cystic areas) were also present (Heywanget al, 2001).

2.3.6 Fibro adenoma

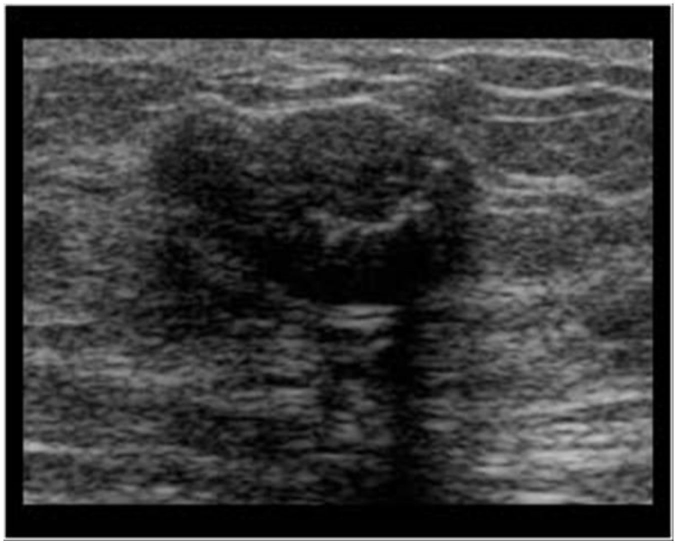

Figure 2.14 fibroadenoma

From: personal collection

Fibro adenomas are lumps composed of fibrous and glandular tissue, firm, rubbery, mobile and varies in sizes.

There is some overlap in the sonographic criteria for fibro adenomas and for breast cancer, and approximately 25% of fibro adenomas appear with irregular margins, which may indicate that the lesions are malignant. Fibro adenomas are typically well defined, oval with smooth lobulated margins; three or fewer lobulations is the second most common shape of fibro adenomas. Sometimes they are accompanied by coarse Calcification develop within fibro adenomas in older women(Heywanget al, 2001).

2.3.7 Lipoma

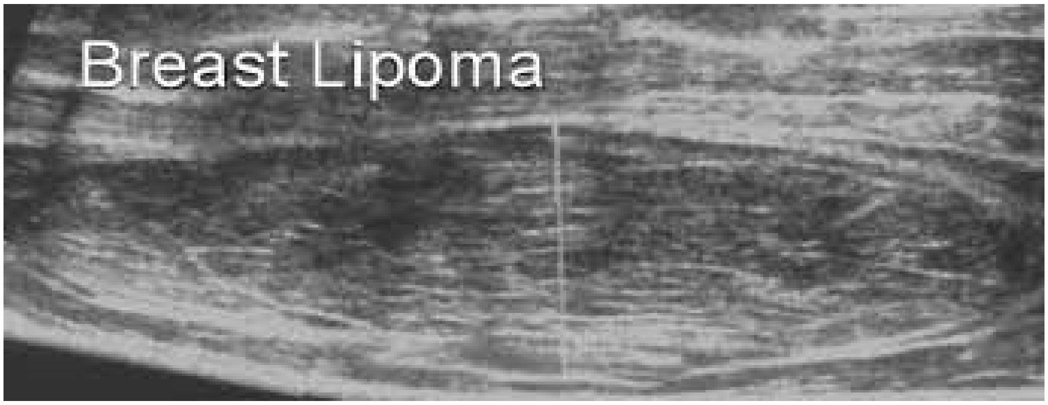

Figure 2.15 Lipoma

From: Personal collection

Lipoma is benign tumor composed mainly of pocket of fat that is encapsulated by a fibrous very well-defined oval compressible mass, often in a superficial location common band. More common in post-menopausal ladies.

There are 3 typical sonographic appearances of breast lipomas. They can be completely isoechoic to surrounding normal fat lobules, mildly hyper echoic to nearby normal fat lobules, or isoechoic when compared to adjacent fat lobules and containing numerous thin, internal echogenic septa(Heywang et al, 2001).

2.4Benign Solid Mass with Risk to be Malignant:

2.4.1 Phyllodes tumor

Figure 2.16 Phyllodes tumor

From: www.ultrasound-image.com

Phyllodescontain 2 types of breast tissue stromal (connective) tissue and glandular (lobule and duct) tissue. Mostly Benign tumors, 10 % percent are malignant. Sonography it is slit-like cystic spaces, very similar to fibro adenomas in appearance.Benign phyllodes tumor its prevalence 60 to 70 % while malignant while phyllodes tumor itsprevalence 25 to 30 %(Heywang et al, 2001).

2.4.2 Intraductal papilloma

Intraductal papilloma is a small, noncancerous (benign) tumor that grows in a milk duct of the breast. Intraductalpapilloma tend to occur in the younger patients, are less often associated with nipple discharge. These

Lesions appear to be susceptible to the development of carcinoma (Sylvia et al, 2001).

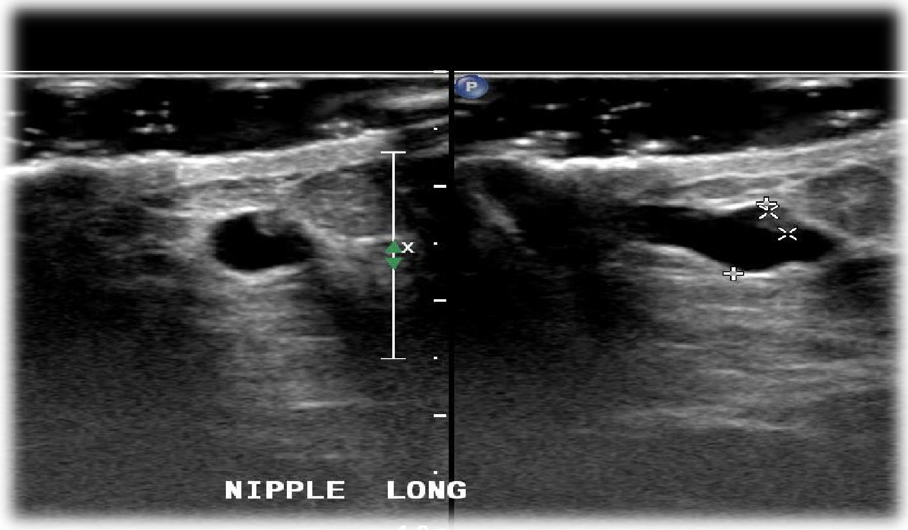

Figure 2.17 Intraductal papilloma

From: personal collection

2.4.3 Diabetic mastopathy

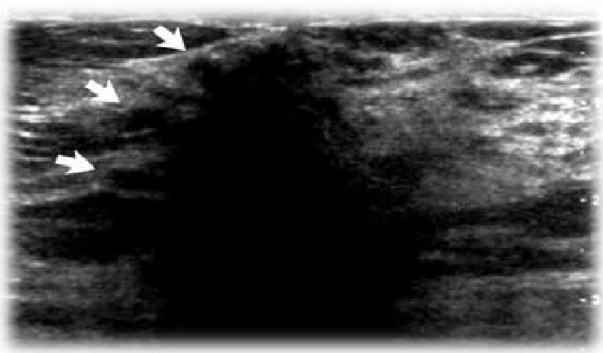

Figure 2.18 Diabeticmastopathy

From:www.medscape.com

Diabetic mastopathy is a benign process found predominantly in patients with type 1 diabetes. These lesions are mainly composed of primarily fibrotic and inflammatory elements. Diabetic mastopathy may mimic malignancy.Sonographyit is hypo echoic lobulated appearance with finger-like projection (Heywanget al, 2001).

2.5Different Types Of The Breast Cancer

Breast cancer cam is classified into two categories:

- Carcinoma in Situ which is non-invasive.
- Invasive Carcinoma

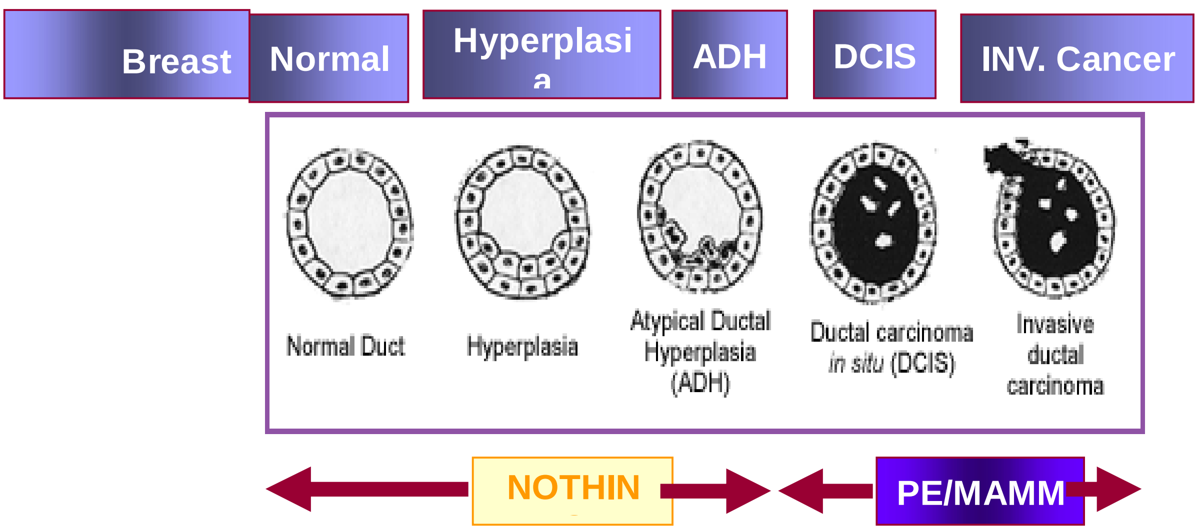

Figure 2.19 Stages of Cancer

The noninvasive carcinoma arise from the ducts and induce no fibrous response in the stroma, as the tumor is isolated from the stroma by a basement membrane .It is difficult to detect the tumor as a lump, when fibrous doesn't occur whereas in invasive carcinoma the adjacent tissue is infiltrated by the tumor cells, invasive tumor may produce various changes at the breast surface due to contraction of the tumor fibrous stroma. It may result in dimpling of the surface or nipple retraction (Nowak, 2004).

2.5.1 Infiltrative ductal carcinoma

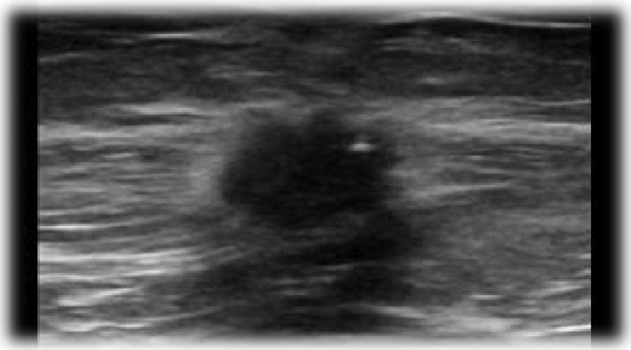

Figure 2.20 Infiltrative ductal carcinoma

From: Personal collection

Infiltrative ductal carcinoma accounts up to 80 % of the breast cancers. It arises from the ductal epithelium, and it may also occur with tubular or invasive lobular carcinoma. Most infiltrating ductal carcinoma has irregular, ill-defined borders on ultrasound. These tumors are usually hypoechoic, solid masses that attenuate the acoustic beam(Rumack, 1998).

2.5.2 Infiltrative Lobular Carcinoma

Infiltrative Lobular Carcinoma is less common than infiltrative ductal carcinoma and only contributesto 8 % -10 % of breast cancers. The tumor cells travel in linear pattern though the breast parenchyma without a central tumor node. When a subtle area is recognized in dense breast, ultrasound can be valuable in confirming the infiltrative mass. It is usually presents as poorly demarcated, asymmetric mass, which may be poor density (Rumak, 1998)

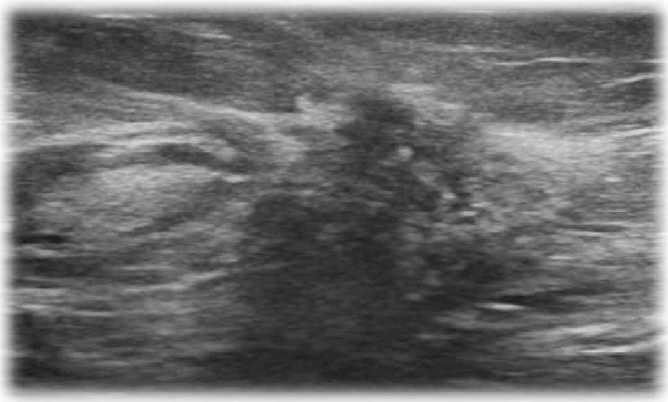

Figure 2.21 Infiltrative Lobular Carcinoma

From: Personal collection

2.5.3 Medullary carcinoma

Medullary carcinoma contributes to 5 % of breast cancers and occurs more frequently in women between the ages of 46-54 years. The typical type may be round well defined hypoechoic and may have posterior acoustic enhancement. Large lesion may also have an echoic areas. The a typical type may more often present with irregular margins with posterior acoustic shadowing (Birdwell, 2003)

2.5.4 Tubular Carcinoma

These tumors occur as frequently as the mucinous carcinoma with a 95% five years survival rate .Ultrasonography they may appear as a small ill-defined hypoechoic mass with posterior acoustic shadowing. Calcification or hyperechoic foci may also be seen(Birdwell, 2003).

2.5.5 Mucinous Carcinoma

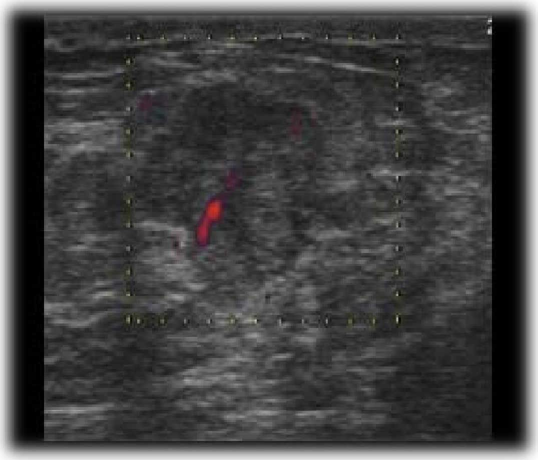

Figure 2.22 Mucinous carcinoma

From: Personal collection

Mucinous Carcinoma constitutes 1 % - 2% of breast cancers and has a better prognosis than infiltrative ductal carcinoma. The tumor is slow growing and more common in postmenopausal women. The sonographic appearance is that of a well –circumscribed, round hypoechoic mass with a homogenous low level internal echogenicity with posterior acoustic enhancement (Rumack, 1998).

2.5.6 Papillary Carcinoma

Papillary Carcinoma occurs mostly in post-menopausal women and has a good prognosis. It may be entirely intraductal or may have areas of invasion. When a bloody nipple discharge is seen, it is suspicious of papillary carcinoma which may appear as solid or complex mass on ultrasound with some solid tissue projecting into a cystic structure (Allen, 2011).

2.6The BI-RADS Assessment Categories

Table 2.2 The BI-RADS Assessment Categories

0	Incomplete	Additional imaging and evaluation is necessary
1	Negative	Breasts are symmetrical with no suspicious lesions
2	Benign	No sign of malignancy , benign lesion found
3	Probably benign	98 % of benignity
4	Suspicious abnormality	Definite probability of malignancy
5	Highly suggestive of malignancy	Lesions have high probability being malignant

From:Madjar H, Mendelson EB (2008)

2.7Literature Reviews

Breast Cancer is the most common malignancy amongst women worldwide (Chala, 2007). The first line of investigation for self-or clinically detected breast masses is usually a mammogram. Breast ultrasound is however an essential component of the imaging evaluation of masses detected on mammograms. The information it gives complements and may even substitute the results obtained by mammography and it could be performed before more aggressive tests such as biopsies are implemented, with a view to avoid them.

Breast sonography which is accessible and economical, can be repeated without side effects and allows the definition of certain tumor characteristics that might help differentiate between malignant and benign tumors (Singh, 2008).

Accurate differentiation between benign and malignant breast nodules could result in improved care and reduction of patient discomfort, morbidity and health care cost.

Several studies were done to assess the accuracy of ultrasound in assessment of breast diseases. Heinig et al. (2008) assess the accuracy of categorization of breast ultrasound findings based on scoring for malignancy using the sonographic breast imaging-reporting and data system (BI-RADS) and they found that scoring breast ultrasound findings for malignancy based on criteria used for BI-RADS breast ultrasound has a high accuracy, comparable to that obtained by BI-RADS for mammography.

In a study carried out at the Department of Radiology, Nottingham City Hospital, Nottingham, UK It was shown that US is a useful adjunct to FNA/core biopsy in confirming the nature of symptomatic, clinically benign breast masses and is superior to mammography in this clinical setting (Lister et al.,1998).

Another study was performed by Lehman et al. (2012) to determine the accuracy and value of breast ultrasound for primary Imaging evaluation of symptomatic women 30-39 years of age who present with focal breast signs or symptoms. They conclude that breast imaging is warranted in women 30-39 years of age with focal signs or symptoms because of the small (1.9%) but real risk of malignancy. Ultrasound has high sensitivity (95.7%) and high NPV (99.9%) in this setting and should be the primary imaging modality of choice. The added value of adjunct mammography is low.

Mammographic screening alone will miss a certain fraction of malignancies, as evidenced by retrospective reviews of mammograms following a subsequent screening. Mammographic breast density is a marker for increased breast cancer risk and is associated with a higher risk of interval breast cancer, i.e. cancer detected between screening tests. Therefore,Nothacker et al. (2009) did a systemic review to estimate risks and benefits of supplemental breast ultrasound in women with negative mammographic screening with dense breast tissue. They concluded that supplemental breast ultrasound in the population of women with mammographically dense breast tissue (ACR 3 and 4) permits detection of small, otherwise occult, breast cancers. Potential adverse impacts for women in this intermediate risk group are associated with an increased biopsy rate.

According to Tardivon (2002), women with dense breasts at mammography or the abnormal clinical examination will benefit from ultrasound because of its high negative predictive value. A study that was done by Taylor (2002) showed the value of using ultrasound as an adjacent to mammography where it enhances the decision to biopsy or even prescribes a follow-up breast examination.

Breast ultrasound is considered mandatory in the evaluation of mammography dense breast in all ages (Kolb, 1998). The accuracy rate of ultrasound for palpable breast tumor when performed by an experienced operator has been reported as high as 95 % and has also been recommended as the best imaging method for palpable breast lesions in young women (Chen, 2003).

Several studies have shown ultrasonography to be more accurate than mammography in measuring tumor size (Tresserra,1999:) (Pierie,1998)(Heiken,2001) (dummin,2007) also stated that ultrasonography as imaging modality is widely available, relatively simple to perform, measures the tumor directly without magnification and may be repeated as necessary, without the concern of extra radiation to the patient. It also provide three dimension tumor evaluation by moving the transducer in multiple planes over the skin until the maximum tumor diameter obtained (Pritt, 2005).

Moreover recent reports have suggested that breast ultrasound (US) is of value in distinguishing malignant from benign nodule and thus is able to prevent unnecessary biopsies of benign nodule which add to the procedural risk, patient discomfort , anxiety and increased cost to be incurred to the patient. The large number of negative biopsies result in unnecessary stress and cost to the patient and the health system (Seghal, 2006).

The classification of suspected benign breast lesion with ultrasound can be helpful in order to reduce the number of unnecessary breast biopsies.

In recent literature by Chala(2007) unnecessary biopsies can be avoided by grey scale ultrasound in the evaluation of the nodule that is considered benign on mammography. Graf (2004) suggested that biopsy can be averted if nodule adhere to the probably benign features on ultrasound and remain stable with follow up procedures. Follow-up ultrasound scan can therefore spare women the trauma of unnecessary, invasive procedure.

Another prospective sonographic study of 3093 breast tumors was conducted by Jackson(1990) to evaluate the predictive ability of sonographic tumor characteristics to differentiate benign from malignant tumors, and they realized that shape, margins, echogenicity, internal echo pattern, retro tumor acoustic shadowing, compressibility, and microcalcification were significant factors in the logistic regression model. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of breast sonography for malignancy
were 86.1 %, 66.1 %, 44.1%, 93.9 %, and 70.8%, respectively. Biopsy of the tumor for pathologic diagnosis is recommended if sonographic features are suggestive of malignancy.

CHAPTER THREE

METHODOLOGY

3.1 Research Setting

This study was conducted in Breast Screening Unit in Well Women Clinic, Mother & Child Health Care center in Sharjah UAE. Breast Screening unit was selected as the most appreciate place to conduct this research, based on fact that it receives all screened ladies from whole Sharjah and north Emirates, therefore; I could anticipate a large enough volume of patient, to allow for the required study sample size to be obtained within a reasonable period of time. As well as it is fully equipped with the mammography machine, ultrasound machine and biopsy.

3.2 Participant Recruitment

3.2.1 Study Population

The study population consisted of all women over the age of 35 who complain of palpable mass and took part in mammographic screening & had a proved solid palpable breast mass.

3.2.2 Sample Size

On consultation with my supervisor it was determined that data from 50 patients and above were adequate for a reliable statistical analysis to be made. 65 consecutive sonography studies of confirmed solid breast lesions obtained between Jan, 2014 and April 2015 as sample size.

3.2.3 Inclusion Criteria:

Ladies who were selected had to comply the following:

- Female over age of 35 years old.
- Female that had presented with solid palpable mass either in clinical examination or with mammogram.
- Approved by histology as solid mass.

3.2.4 Exclusions Criteria:

- Ladies younger than 35 years old were excluded from this study as screening mammography is only recommended to start at the age of 35 years old.

3.3 Research Design:

Quantitative cross section retrospective design was employed to this study as it was the most appreciate design to be used.

3.3.1 Cross-Sectional design

Cross sectional studies are used to examine data at one point in time .Data is therefore collected on a single occasion from different subjects, rather than obtaining data from the same subjects at several points in time. (Bink, 2006).

3.3.2 Quantitative & Prospective Research

Quantitative was used to quantify the problem by way of generating numerical data or data that could be transformed into useable statistics. While Retrospective as its study on ladies that had masses already approved solid mass by biopsy.

3.4 Instrumentation

Breast ultrasound studies would be performed with GE Healthcare – KretztechnikVoluson ® 730 Expert (BT05, BT08) serial number (AE1211US01) using high frequency probe.It is always being monitored and calibrated twice a year.

3.5 Ultrasound Evaluation And Protocol:

3.5.1 Introduction

In order to perform good breast ultrasound, scanning experience is one of the most critical factors and really the only way to develop an appreciation of the strength and limitation of the ultrasound in imaging of the breast.

Scanning was performed in two orthogonal planes, transverse and sagittal planes to facilitate through covering of the entire breast. One should overlap the previous scan path slightly with each strip of breast scanned. When a suspicious area in the breast was detected, the transverse and sagittal section enhanced with radial and anti-radial planes.

3.5.2 Patient position

Before the sonography examination was performed, the patient was positioned so the area of the interest was thin as possible, minimizing the imaging depth. It was best to examine the patient in the supine position with the ipsilateral arm extended above the head to produce a natural spreading of the breast on the chest wall. The elevated arm position also tightened the pectoral muscles, which further flattened and stabilized the breast .with larger breasts, a degree of elevation under the shoulder blade might have been required in order to center the breast. This could be accomplished with a foam wedge or roll of towels.

3.5.3 Scanning technique:

Two techniques have been followed:

- Grid scanning pattern
- Radial scanning pattern (Clock-face).

3.5.3.1 Grid Scanning Pattern:

a. Transverse Pattern:

The transducer was placed in a transverse position on the superior-lateral aspect of the upper outer quadrant with the transducer notch positioned to the patient's right. The transducer was slided into an inferior direction then scan continued slightly beyond the inferior margin of the breast. The transducer was moved medially in position (while still maintaining overlap within the lower outer quadrant) and then in a superior direction to cover the medial aspects of the breast. The same method should be used for the inner quadrants.

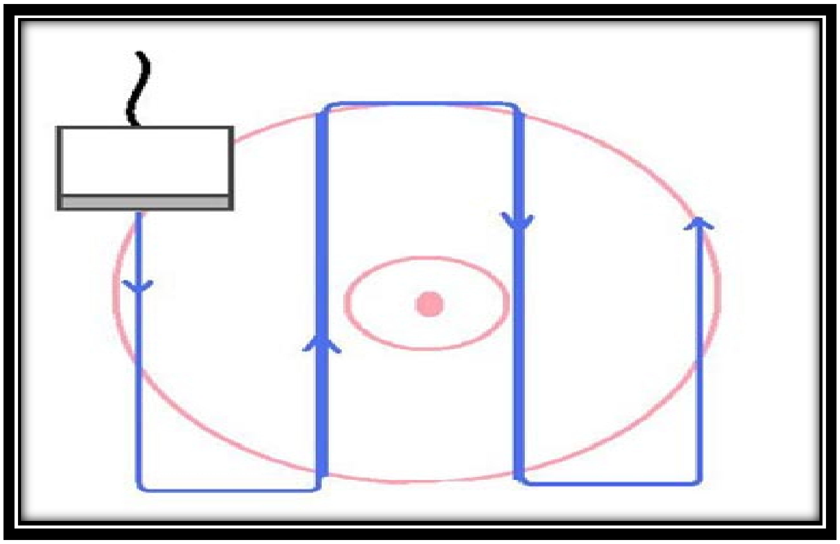

Figure 3.1 Transverse scanning plane of breast.
From www.ultrasoundpaedia.com

b. **Sagittal pattern**

The transducer was placed in longitudinal (sagittal) position on the superior-lateral aspect of the upper outer quadrant of the breast with the transducer notch directed towards the patients head. The transducer was slided across the upper quadrants, in a medial direction, to scan the superior aspects of the upper outer quadrants and upper inner quadrant to the sternum. When the sternum was reached, the transducer was moved inferiorly in position while maintaining overlap within the upper inner quadrant and then in a lateral direction scanned the inferior aspect of the upper inner quadrant and upper outer quadrant. The process was repeated for the lower quadrants.

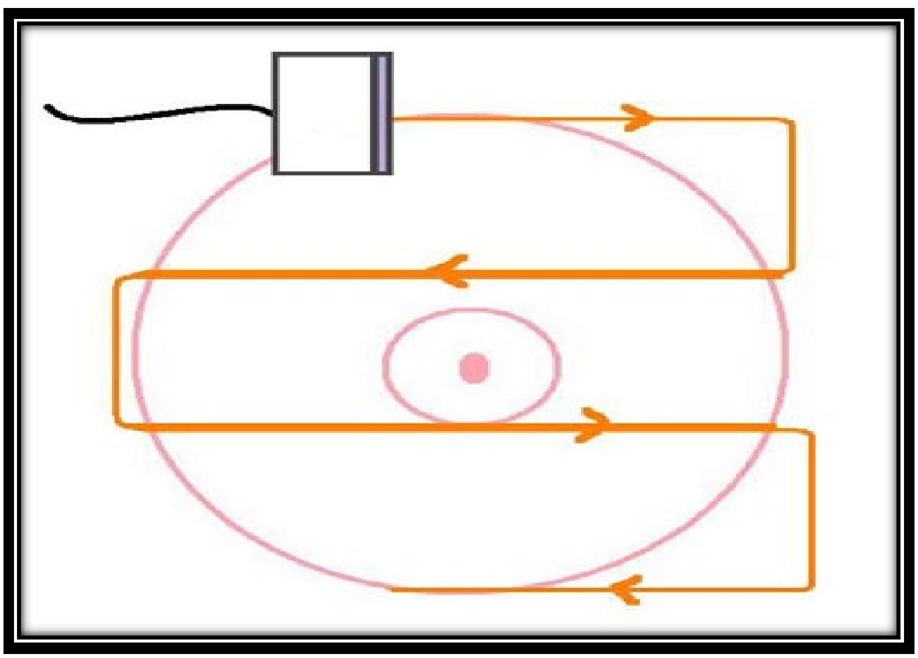

Figure 3.2 Sagittalscanning of breast

From www.ultrasoundpaedia.com

3.5.3.2 Radial Scanning Pattern

a. Anti-radial survey

The transducer was placed in the 12 o clock position at the outer margin of the breast where the transducer was rotated in the anti-radial plane. It was then moved from the outer aspect of the breast towards the nipple. The scan continued in each clock positions in the anti-radial plane until the 12 o'clock position was reached again.

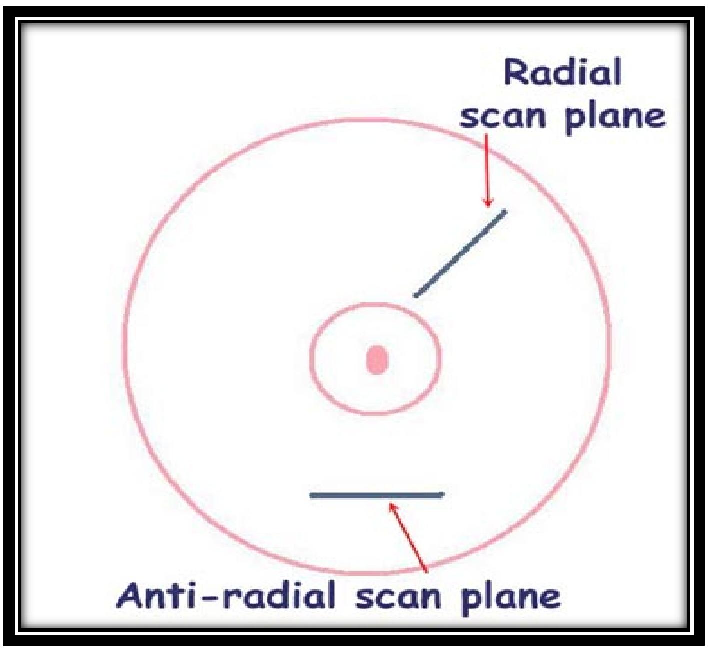

Figure 3.3 Anti-radial scanning plane of breast.

From www.ultrasoundpaedia.com

b. Radial Survey

The transducer was placed in the radial plane in the 12 o clock position, with the left side of the transducer (notch or light) facing the nipple. The breast was scanned along the radial plane by rotating through the clock position, where it started from 12 o'clock position, in a clockwise direction toward the 3 and 6 o'clock position. When the 6 clock position was reached, the transducer was re-oriented so that the right side edge of the transducer was in contact with the nipple (with the notch facing away from the nipple).Scanning continued in the clockwise direction toward the 9 and 12 o clock positions.

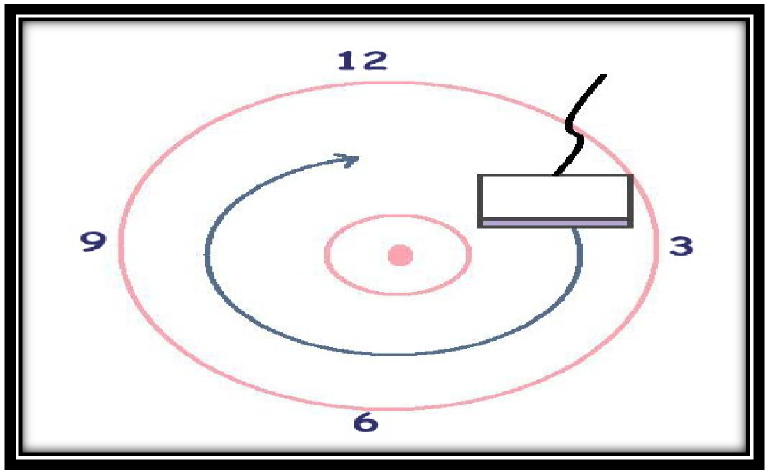

Figure 3.4 Radial scanning plane of breast.

From www.ultrasoundpaedia.com

3.5.4 Ultrasound characteristic of solid breast nodules

The solid masses were evaluated according to their sonography features as following:

- Size
- Orientation
- Shape (round ,oval, irregular)
- Echo density (hypo echoic, hyper echoic ,isochoric)
- Echo pattern (homogenous or inhomogeneous)
- Posterior acoustic properties (posterior wall enhancement or acoustic shadow)
- Architecture of surrounding tissue
- Vascularity.

3.6 Research Data Collection:

3.6.1 Data collection Technique

Data was collected by obtaining the profile of patients who presented with a palpable breast mass with regards to age and family history of breast cancer and approved as solid masses histologically.

3.6.2 Reliability & Validity

The observations that made on the solid breast masses were verified by a senior radiologist. While Breast ultrasound studies were performed with GE Healthcare –KretztechnikVoluson ® 730 Expert Ultrasound Machine which always is monitored and calibrated twice a year.

3.7 Data Analysis

Cross tabulations were employed to present the data. Each ultrasound finding wascategorized as either benign or malignant

One point was given for each finding. The totalnumber of benign and malignant findings was tailed.The percentage of malignant findings was calculated as percentage of the total. If no malignant findings were found, the lesion was classified as benign while if only 2 % of probability of malignancy the lesion was classified as probably benign. If there were 49% or less malignant findings, the lesion was classified as indeterminate. Those with either 50% or more malignant findings were classified as malignant. The ultrasound findings were then compared with histology results.The validity of ultrasound in the assessment of the palpable breast mass has been determined by the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasound in distinguishing a malignant mass.

The most discriminating ultrasound characteristics required in differentiating benign and malignant masses were presented as cross tables and graphs enhanced by p-values of tests done to prove statistical significance.

The Pearson Chi-square test was used for measuring the strength of the linear relationship between two variables or more. A low p-value for this test (less than 0.05) implies that there is evidence to reject the null hypothesis or that there is a statistically significance relationship between the two variables. Fisher Exact test and Cramer's V test were used as well in some cases.

3.8 Ethical Consideration

Ethical clearance was obtained from Sudan University before the study would commence.Anonymity was ensured by mean of patient identification through a research number. No personal information concerning the examination were divulged to anyone who was not involved in the study .The result of this study were published only in the form of tables and graph together with all p-values of all significance tests done.

CHAPTER FOUR

RESULTS

4.1. Profile of patients with a palpable breast mass

Although age and family history were not objectives for this study, they were described to use this information as matter of interest .Not enough data was collected under the age of 35 to use it as cut off point,therefore the sample size was divided into two groups, first group was between 35 and 45, and the second group was above the age of 45, menopause ages.

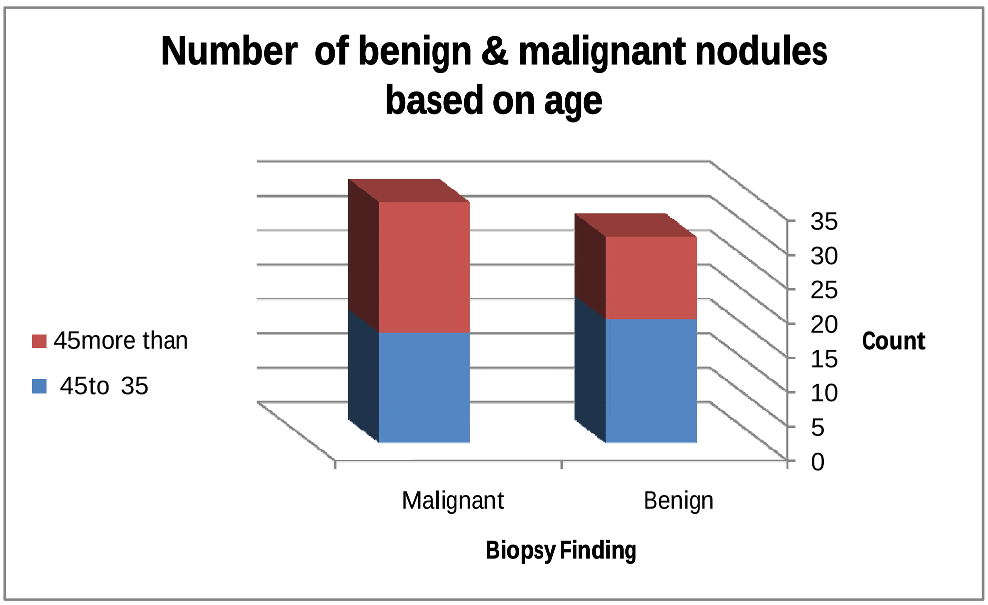

Figure 4.1 Number of benign and malignant solid nodules based on age.

Sixty five patients aged between 35 and 63 years had presented with a palpable breast mass. The majority of patients (68.6%) were in the third and fourth decades. The 16 patients with amalignant breast mass were aged between 35 and 45 years while the rest of malignant 19 patients were aged above 45 years old,the staging of the menopause age.

There were 34 women who had solid palpable breast mass with no family history of the breast cancer and the rest 31 women with a family history of the breast cancer. Only 7 patients (20 %) with a malignant histopathological finding had a family history of breast carcinoma.

4.2 Ultrasound findings of the palpable breast mass

Table 4.1: Ultrasound Finding of the Palpable Breast Mass	
Ultrasound Finding	**Number of Patients (%)**
P. Benign	14 (21.5 %)
Indeterminate	24 (36.9 %)
Malignant	27 (41.5 %)
Total	65 (100%)

The majority of lesions biopsied had malignant ultrasound findings (Table 4.1).

4.3 Histopathological Results

Table4.2: A comparison of the ultrasound findings with thehistopathology results of the palpable breast solid mass:

Ultrasound Finding	Histology		Total
	Benign	Malignant	
P. Benign	14	0	14
Indeterminate	16	8	24
Malignant	0	27	27
Total	30	35	65

The ultrasound findings had detected 27 (41.53%) malignant lesions. All of these were confirmed malignant on histopathology and none of these cases were benign. Of the 35 malignant cases, 14 had infiltrating ductal carcinoma which is the most common type followed with papillary ca, mucinous and lobular Ca.

None of the breast lesions classified as P. benign on ultrasound proved to be malignant on histopathology.

4.4 Validity of the Ultrasound in the assessment palpable solid masses

For the purpose of calculating sensitivity, specificity, positive predictive value negative predictive value and accuracy of ultrasound in distinguishing a malignant lesion, the ultrasound findings and histology results were re-grouped (Table 4.3).

The lesions classified on ultrasound as indeterminate and malignant were grouped together.

Table 4.3: Validity of Ultrasound in Assessment of Palpable Breast

Ultrasound Finding	Histology		Total
	Benign	Malignant	
P. Benign	14 (TN)	0 (FN)	14
Malignant *	16 (FP)	35 (TP)	51
Total	30	35	65

Note	
TN : True Negative	
TP :True Positive	
FN : False Positive	
FP : false Positive	
Sensitivity: TB/(TP+FN)	100%
Specificity: TN/(TN+FP)	46.66%
Positive PredictiveValue's/(TP+FP)	69%
Negative Predictive Value: TN/(TN+FN)	100%
Accuracy: (TP+TN) / (TP+ TN +FP +FN)	75%
Malignant * : Malignant & Determinate	

Ultrasound had a sensitivity of 100%, specificity of 46.66%, positive predictive value of 69%, and negative predictive value of 100% and accuracy of 75% for distinguishing a palpable solid malignant mass from benign masses.

4.5Comparison of ultrasound technique in differentiation benign from malignant breast nodules

A statistical comparison of ultrasound technique was performed to ascertain to what degree each contribute to the accuracy with which benign versus malignant breast nodule can be characterized .It was hypothesized that a combination of ultrasound characteristic can be successfully used to distinguish between benign and malignant breast nodules with the hope of decreasing the large number of biopsies routinely performed for benign breast abnormalities.

4.5.1 Size of the nodule

Table 4.4: Size of solid nodule:

		Ultrasound Finding		Total
		Benign	**Malignant**	
Mass Size	< 3 cm	24 (60%)	16 (40)%	40 (100%)
	> 3 cm	6 (24%)	19 (76%)	25(100%)
Total		30 (46.15%)	35 (53.85%)	65 (100%)
Pearson Chai Square Test				**P-Value** 0.004619

This table shows a trend that larger nodules showed ultrasound characteristics in keeping with malignancy.
With a Pearson Chi-Square value, a statistically significant p-value of 0.004. The null hypothesis is rejected in this variable.The Pearson Chi-Square test measures the strength of the linear relationship between two variables. A low p-value for this test (less than 0.05) means that there is statistically significant relationship between the two variables.

4.5.2Shape of the nodule

Table 4.5: Shape of solid nodule

	Ultrasound Finding			
		Benign	**Malignant**	**Total**
Regular Shape	Round	12 (92.31%)	1 (7.69 %)	13 (100 %)
	Oval	14 (93.33)	1 (6.67%)	15 (100 %
Irregular Shape		4 (10.81 %)	33 (89.2 %)	37 (100 %)
Total		30(46.15%)	35(53.85%)	65(100%)
Pearson Chai Square Test				**p-value** 0.00

The Pearson Chi-Square test shows that the results are statistically significant when result with p-value of 0.000for the shape.

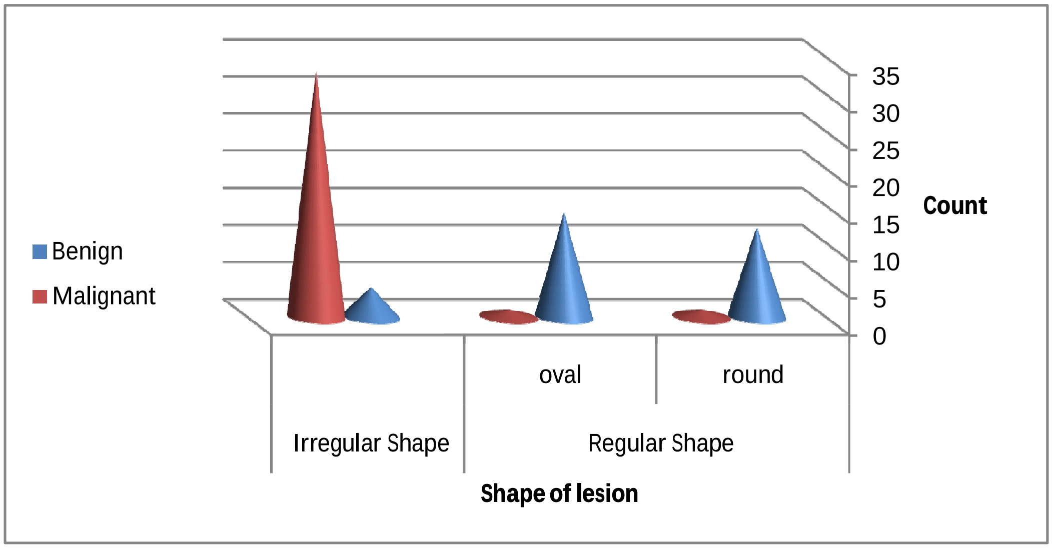

Figure 4.2: Bar chart for shape of the nodule on ultrasound

The bar chart demonstrated the relationship between the shape of the nodules and their likelihood for malignancy as per ultrasound characteristics.

4.5.3 Margin of the nodule

Table 4.6: Margin of the solid nodule

		Benign	Malignant	Total
Well defined		12 (92.30 %)	1 (7.69 %)	13
Partially well defined		4(50 %)	4 (50 %)	8
Lobulation	Macrolobulation	7(87.5 %)	1(12.5 %)	8
	Microlobulation	2 (25 %)	6(75 %)	8
Irregular or speculated		5 (17.86 %)	23(82.12 %)	28
Total		30	35	65

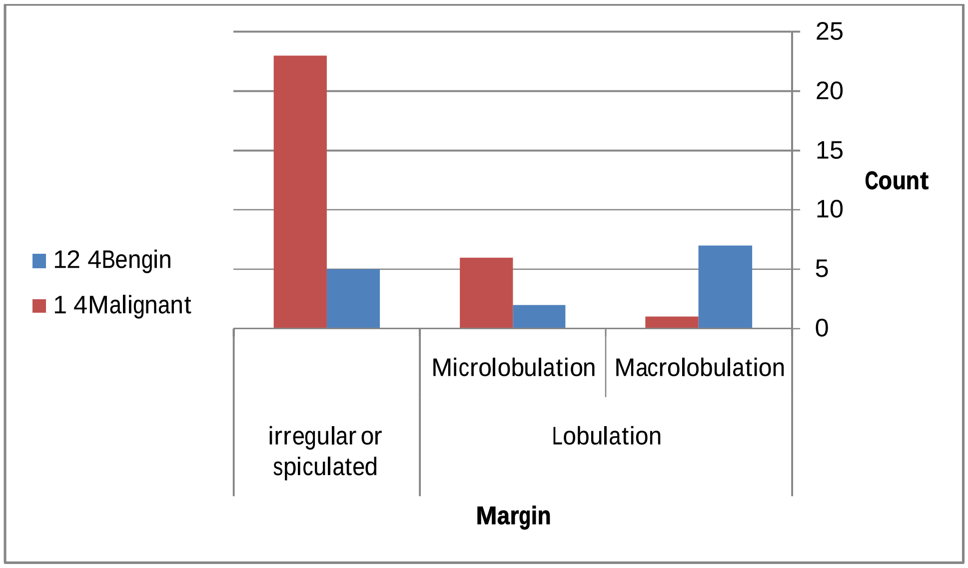

Figure4.3: Bar chart for margin of the nodule on ultrasound

The bar chart demonstrated the relationship between the margin of the nodules and their likelihood for malignancy as per ultrasound characteristics.

4.5.4 Echo density of the nodule

Table 4.7: Echo density of the solid nodule

		Ultrasound Finding		**Total**
		Benign	**Malignant**	
Echo density	Hyperechoic	0	0	0
	Hypoechoic	27 (45%)	33(55%)	60(100%)
	Isoechoic	3 (60%)	2(40%)	5(100%)
Total		30 (46.15%)	35 (53.85%)	65(100%)
Pearson Chai Square Test			0	**P-Value** 0.518008

sixty out of 65 lesions appeared hypoechoic on ultrasound. From results it appears as if echodensity is not strong predictor of malignancy.

The Pearson Chi-Square test showed p-value 0.518 which indicated that the test between the variables was not statistically significant, as was to be expected.

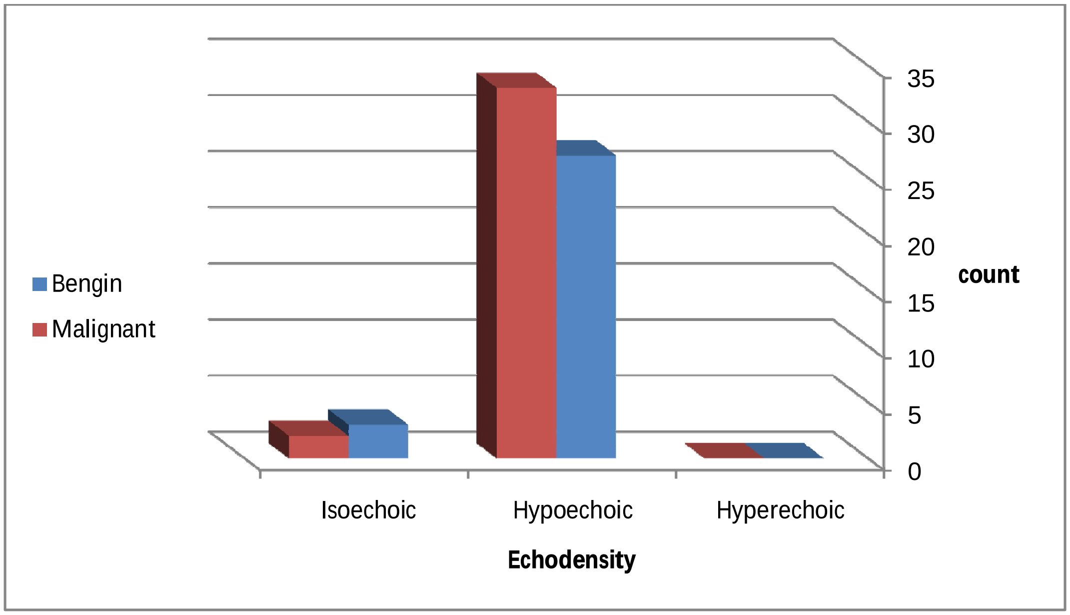

Figure4.4: Bar chart for echo density of the nodule on ultrasound

The bar chart demonstrates the most solid nodules, both benign and malignant, appeared hypoechoic on ultrasound.

4.5.5 Echopattern of nodule

Table 4.8: Echo pattern of the solid nodule

		Ultrasound Finding		**Total**
		Benign	**Malignant**	
EchoPattern	Homogenous	13 (68.42%)	6 (31.58%)	19 (100%)
	Heterogeneous	17 (36.96%)	29 (63.04%)	46 (100%)
Total		30 (46.15%)	35 (53.85%)	65 100%
Fisher's Exact Test				**P-Value** 0.029083
Cramer 's V Test				**P-Value** 0.025

The Fisher's Exact test showed a p-value of 0.02, which is statistically significant. However, the result of the Cramer's V test show a small effect size of 0, 27 which is an indication of a small association between echo pattern of a nodule and the likelihood of malignancy.

4.5.6 Posterior acoustic properties of nodule:

Table 4.9:Posterior acoustic Properties of nodule

	UltrasoundFinding			
		Benign	**Malignant**	**Total**
Acoustic Properties	Shadowing	3(21.42%)	11(78.57%)	14
	Enhancement	6 (75%)	2(25 %)	8
Absence of Acoustic Properties		21 (48.8 %)	22 (51.1%)	43
Total		**30**	**35**	65
Pearson Chai Square Test				P-Value 0.544

The description of posterior acoustic features is reported in Table 4.9. Forty three out of 65 cases showed no posterior acoustic, Therefore, the test between the variables was not statistically significant.. It could therefore be argued that acoustic shadow increase the risk of malignancy if it is associated with other malignancy features.

4.5.7 Orientation of the solid nodule

Table 4.10: Orientation of the solid nodule

		Ultrasound Finding		**Total**
		Benign	**Malignant**	
Orientation	Horizontal	26 (68.42%)	12 (31.58)	38 (100 %)
	Vertical	4 (14.81%)	23 (85.19)	27(100%)
Total		30(46.15%)	35(53.85%)	65 (100%)
Pearson Chai Square Test				**P-Value** 1.9E05.
Fisher's Exact Test				**P-Value** 1.8E05.

More malignant nodules were vertical while most of benign nodules were horizontally oriented. With p-value < 0.05 it is shown from the result that Chai square test is statisticallysignificant. The Fisher Exact test shows a p-value < 0.05 of which is statistically significant.

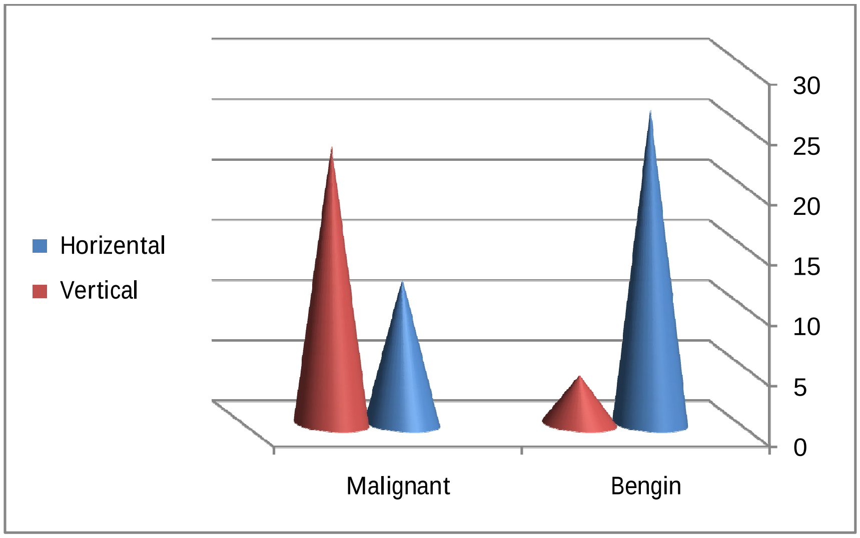

Figure4.5: Bar chart for orientation of the nodule on ultrasound

The bar chart shows the most malignant nodule were oriented vertically while the most benign nodule were oriented horizontally.

4.5.8 Surrounding tissue distortion by nodule

Table 4.11:Surrounding tissue distortion by the nodule

		Ultrasound Finding		Total
		Benign	**Malignant**	
Tissue Distortion	Yes	2 (9.09%)	20 (90.9%)	22 (100 %)
	No	28 (65.12)	15 (34.88)	43 (100 %)
Total		30(46.15%)	35(53.85%)	65 (100%)
Pearson Chi-Square test				P-Value 1.8E-05
Fisher's Exact test				P-Value 1.5E-05.

Both the Fisher's Exact test and Chi-square results showed a p-value < 0.05 which is statistically significant. Ultrasound feature of the tissue distortion can therefore be highly associated with malignancy.

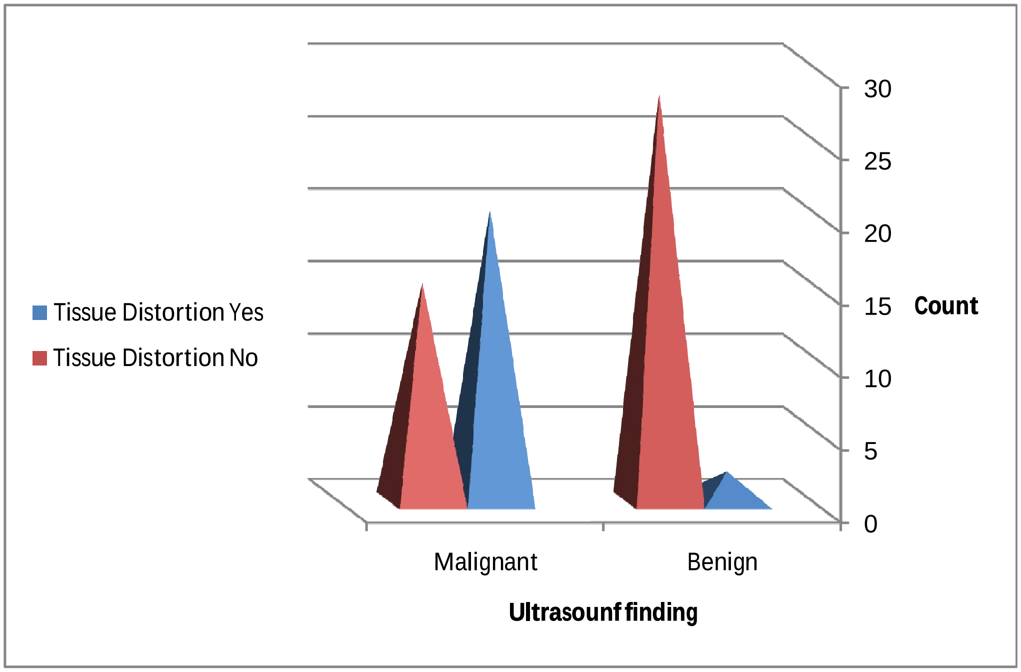

Figure4.6: Bar chart for architecture distortion of the nodule on ultrasound

The bar chart shows clearlyhow architecture distortion is not associated benign nodules.

4.5.9 Doppler assessment for vascularity

Table 4.12:Doppler Assessment for the nodule

	Benign	**Malignant**	**Total**
Central vascularity	5 (41.67 %)	7 (58.33%)	12 (100 %)
Non Vascular or PeripheralVascularity	25 (47.17 %)	28 (52.83 %)	53 (100 %)
	30(46.15%)	35(53.85%)	65 (100%)
Pearson Chai Square Test			**p-vale** 0.729866

Doppler flow assessment of the vascularity of nodule as a predictor of malignancy assumes malignant nodules more often had an increased vascularity while benign nodules didn’t show increased angiogenesis .However, according to the results shown by the Chai Squaretest, the test is believed to be statistically not significant.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

Sixty five patients aged between 35 and 63 years had presented with a palpable breast mass. The majority of patients (68.6%) were in the third and fourth decades. The 16 patients with amalignant breast mass were aged between 35 and 45 years while the rest of malignant 19 patients were aged above 45 years old,the staging of the menopause age. This age of incidence of benign and malignant breast disease was consistent with other series (Kopan, 1990) (Gordon, 1995).

Women over 40 years old have a greater risk of developing breast cancer and the incidence increases progressively until the age of 70 (Bassert ,1990).

Less than 0.3% of breast cancer occurs in women under the age of 30. A mass in a woman in this age group is almost invariably a benign breast lesion (Kopan, 1990) (Gordon, 1995). Younger women are more sensitive to the potential negative effects of ionizing radiation. Therefore in patients with a palpable breast mass who are under the age of 30 years and are not at risk because of a strong family history of breast cancer, ultrasound and not mammography should be the initial imaging modality (. Jackson,1990) . However, the value of ultrasoundas a screening tool in young asymptomatic women is not justified because the incidence of breast cancer in this age group is very low(Kopan, 1990) (Gordon, 1995).

The analysis of the epidemiology of breast cancer has identified several factors associated with the increased risk of breast cancer and these include: early age of menarche, later age of menopause, null parity, late age of first pregnancy, obesity, high dose exposure to radiation, not breast feeding, history of benign breast lesion, alcohol consumption, a diet high in animal fat and family history of breast cancer. Majority of factors are not particularly of high risk and are generally associated with a relative risk of less than 3.0. Family history is generally reported as among the more important risk factor associated with breast cancer. For women with a family history of breast cancer in both a mother and a sister, the adjusted relative risk is 13.6(Gordon, 1995).

In our study there were 34 women who had solid palpable breast mass with no family history of the breast cancer and the rest 31 women with a family history of the breast cancer. Only 7 patients (20 %) with amalignant histopathological finding had a family history of breast carcinoma.However, these findings are not statistically significant because of our small study population.

In assessment of the palpable breast mass, thesensitivity of ultrasound was 100%, specificity was46.66% and accuracy was 75% for differentiation of amalignant mass. The positive predictive value was 69% and the negative predictive value was 100%. Theseresults are comparable with previous series (Sicklesetal.1984) (Tohnoet al.1994).

In this study (table4.4),a trend is evident that most breast nodules > 3 cm demonstrated ultrasound characteristics in keeping with malignancy. Paulnelli et al (2005) also reported in their study that the risk of malignancy in solid breast nodules increases with tumor size.

Ultrasonography, in general has greater ability than mammography to demonstrate nodule characteristics and to measure the size of nodule accurately. This is partly due to the ability of the transducer to be maneuvered through multiple planes to acquire multiple views and dimensions of the nodule and the elimination of magnification of structure, which is inherent to mammography.

According to Constantini(2006) the shape of the nodule is the most reliable criterion for differentiating between benign and malignant breast nodules. While benign breast nodules are mostly round or oval, malignant nodules are found to be irregular in shape.

The results of this study concur with current literature with majority of round nodule, 92.31 % (12) being benign while 89.2 % of malignant breast nodules were irregular in shape. In addition 93.33 % of benign breast nodules presented with an oval shape.

As regards diagnostic properties found by several authors and in the present study (Table 4.6), the irregular margins (microlobular, speculated)was theecho graphic characteristic might be a powerful tool for helping the observer to differentiate malignant tumors from the benign ones.

Alvarenga et al. (2003), utilized a method based on mathematical morphology for images segmentation, have found 95.7% sensitivity and 96.7% specificity in the differentiation of tumors by means of margins analysis.

However it is important to note that there is an overlap of the sonographic features, and some of these sonographic findings may be seen with benign breast lesions. For example in the fibro adenoma typical features area well-circumscribed ellipsoid with a horizontal diameter greater than the AP diameter. Unfortunately, as fibroadenomas enlarge, they have a tendency to become multilobulated and more irregular in shape.

Echogenicity is the shadeof gray constituting the lesion, ranging from markedly hypoechoic. which is essentially black, to intensely hyperechoic, which is primarily white.In study done by Stavros (1995:130) most malignant breast nodules appeared hypechoic compared to adjacent fatty breast tissue, which agrees with the results of our study in which 55 % (33) malignant breast nodules appeared hypoechoic. But this is not reliable characteristic as this study shows both benign and malignant appeared hypo echoic on ultrasound. Several author's (Stavros, 1995) (Kossoff, 1999) (Rahbar et al. 1999)considered echo density is one of the features thatis notsignificant for lesions classification.

The definition of the echotexture of a lesion as homogeneous or heterogeneous depends on the diversity of the tissues in such lesion. For example, a lesion might be heterogeneous for presenting areas of necrosis (carcinomas) or due to fibroadenomas (benign) hyalinization(Chen, 2004). So, the utilization of this single characteristic might lead to misinterpretation.

In this study the echo pattern was of limited usefulness in differentiating benign from malignant nodule.The absence of a prognostic value of this variable was described by Skaane and Engedal(1998). Also, it is important to note that in the new standardization of the American College of Radiology, this feature was not taken into consideration.

Literature suggests that it is not common for benign breast nodules to present with acoustic shadowing (Stavros , 1995), however in this study acoustic shadowing was present in three benign nodules , two of them their histopathological result were radial scar with atypical hyperplasia and one with hyalinized fibroadenomas. This finding is in concordance with a study by Weinstein and co-worker (2004) which reported that a spectrum of benign nodules exhibited posterior acoustic shadowing, for example once the fibroadenoma begins to undergo hyalinization, posterior acoustic shadowing may be seen as shown in figure 5.1. Up to 30% of non-calcified fibroadenomas may exhibit posterior acoustic shadowing (Mendelsonet al., 1998) .This sonographicshadowing may be confusing to the imager if not recognized as part of a spectrum of sonographic findings of hyalinized fibroadenomas. In some cases, the shadowing is seen from the margin of the lesion, giving a slightly different appearance than the more typical central shadowing of cancer.Additionally, the degree of shadowing does not appear to be as dense as in the case of some malignancies that exhibit this characteristic, and the posterior wall of the fibroadenoma is often visible as a thin echogenic margin, as shown in the example.

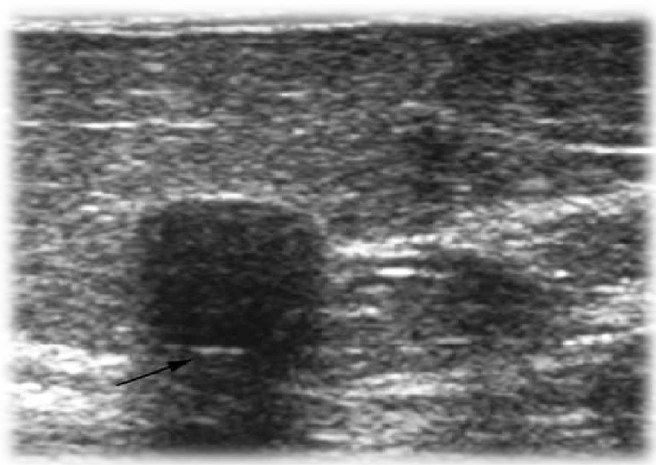

Figure 5.1 Sonogram showing a hypoechoic nodule with posterior Acoustic shadowing. The echogenic sharp posterior margin of The mass (arrow) is shown through the region of shadowing.

Radial scars are benign lesions of unknown etiology that can mimic also a malignancy on imaging and pathologic evaluation .At sonographic evaluation, a hypoechoic mass with dense posterior acoustic shadowing may be seen. There are no sonographic features that would distinguish this from a malignancy (CohenandSferlazza, 2000).In this case the combination of the clinical and sonographic features may suggest the diagnosis. Even though imaging features may suggest the diagnosis of a radial scar, biopsy is recommended.

I could say that posterior acoustic shadowing is a sonographic characteristic that is most commonly associated with breast malignancies, 78.57 % malignant nodules presented with acoustic shadowing , however, it is important to keep in mind that this sonographic finding may also be seen in benign breast masses such as fibroadenomas ,surgical scar,diabetic Mastopathy ,fatnecrosis.(Weinstein ,2004).

The clinical history and mammographic findings, in conjunction with the sonographic findings, will often lead to the correct diagnosis.

The ‘taller than wider’ characteristic (vertical orientation), shown in Table 4.10, means that the nodule has a greater AP dimension than its transverse .This appearance is found speciallyin invasive cancer of the breast, and indicates that the lesion is growing across tissue planes rather than within them, and is more likely to be seen in malignant lesions than in benign lesions as this study approved. More malignant nodules were vertical while most of benign nodules werehorizontally oriented.

Intraductal carcinoma may not demonstrate these findings. Such intraductal lesionsmay have duct extension, branch pattern, extension into ducts, or microlobulation. To demonstrate these findings, the lesion must be scanned in the plane of the ductal system (i.e. radially and antiracially).

An antiparallel orientation was an important predictive malignant sign if associated with other predictive malignant descriptors.

According to the literature (Stavors et al, 1995), the presence of altered architecture in tissue surrounding a breast nodule, is suggestive of malignant tissue infiltration. In our study %90.9 (20) of the masses displayed altered tissue architecture were malignant, which is statistically significant and in agreement with results from previous studies. Ultrasound features of tissue infiltration are therefore highly suggestive of malignancy.

Color Doppler evaluation of solid lesions has not been found sensitive enough to distinguish benign from malignant lesions, Doppler flow assessment (central vascularity) detected in only 12 breast nodules out of 35 malignant nodules.

In a color Doppler study of breast masses, it was reported that subjective evaluation revealed color signals were more commonly found in malignantthan benign lesions(Buada et al. ,1997).

Doppler ultrasound demonstrated that extensive color signals (indicating a highly vascular lesion) were suspicious for malignancy. However, infection has to be considered as a differential diagnosis (Cosgroveet al., 1993).

Fivebenign lesion in this study showed few color signals and their diagnosis were fibroadenoma. So for lesions that show few color signals, either benign breast change or fibroadenoma must be considered as the differential diagnosis as approved in other studies. A study conducted by

Birdwell et al (1997) showed that fibroadenomaslarger than 2 cm were also found to be vascular.

5.2 Conclusion

This study shows that ultrasound is valuable in the characterization of the solid palpable breast mass. US had high sensitivity of 100% and accuracy of 75% for distinguishing a palpable solid malignant mass from benign masses .There are sonographic criteria that help guide in differentiating benign lesions from questionable ones that need to undergo biopsy . Main benignancy criteria were: well defined shape, regular contour, homogeneous echo texture, and horizontal orientation. While irregular shapes,indistinct margins, vertical orientation and tissue distortion were powerful indicators for malignancy. Echographic characteristics as acoustic shadow and central vascularity if it is associated with other malignant features it increases the risk of malignancy. Therefore, A combination of sonography characteristics

might improve the sensitivity of breast sonography in the diagnosis of breast tumors.

In conclusion, the results of our study were encouraging in that we were able to identify the most applicable US features for differentiating benign from malignant solid masses. These features have the potential to help decrease the number of biopsies performed for benign solid masses. In a busy hospital, ultrasound is a useful tool to screen and identify patients who require early surgical excision and those who require follow-up only. There is no physical hazard to the patient and the procedure is comfortableand well tolerated. However, it must be emphasized that strict adherence to the criteria for benign and suspicious lesion is required as there are some overlap feature between them.

5.3 Recommendations

Although sonography has definite role in differentiating benign nodule from malignant one it is important to have multi-disciplinary assessment based on clinical , imaging and histopathology if needed .This may Eventually expand the specificity of sonography for the evaluation of solid masses, further reducing the need for excisional biopsies.

Other recent ultrasound modalities such as elastography , contrast enhancement and 3D ultrasound, maybe used in conjunction with B-mode ultrasound to further improve the sensitivity of ultrasound to predict malignancy.

A multicenter study, using a larger sample size will be beneficial in providing a better reflection of UAE population.

Quality of performance standards and a uniform assessment system, such as the ultrasound BI-RADS™ categories, should be applied, so that the precise reasons for the biopsies can be given and explained accurately

I think that practice and periodic review of cases should be performed for accurate detection and interpretation of sonographic descriptors. However, further prospective randomizedtrials are needed to confirm findings.

REFERENCES

Allen PL, Baxter GM, Weston MJ (2011). Clinical Ultrasound. 3rd Edition, Churchill Livingstone, Edinburgh.

American College of Radiology. Illustrated Breast Imaging Reporting and Data System Atlas (BI-RADS®): Ultrasound. 4th ed. Reston: American College of Radiology, 2003.

Bassert LW. Mammography and breast cancer screening. Surgical Clinics of North America 1990; 70: 755-800.

Birdwell, R., Ikeda, D., Jeffrey, S. and Jeffrey, R. (1997). Preliminary experience with power Doppler imaging of solid breast masses. *American Journal of Roentgenology*, 169(3), pp.703-707.

Brink, H., Van der Walt, C. and Van Rensburg, G. (2006). *Fundamentals of research methodology for health care professionals*. Cape Town.

Buada LD, Murukami J, Muruyama S, et al. Colour Doppler sonography of breast masses: A multiparameter analysis. *Clinical Radiology* 1997; 52: 917-23.

Burns PE. False negative mammograms and delay in diagnosis of breast cancer. N Engl J Med 1978; 299:201-2.

Chala L, de Barros N (2007). Breast evaluation and imaging methods. *RadiologiaBrasileira* .40 (1): 4-7.

Chen, S., Cheung, Y., Su, C., Chen, M., Hwang, T. and Hsueh, S. (2004). Analysis of sonographic features for the differentiation of benign and malignant breast tumors of different sizes.*Ultrasound in Obstetrics and Gynecology*, 23(2), pp.188-193.

Cohen MA, Sferlazza SJ. Role of sonography in evaluation of radial scars of the breast. AJR Am J Roentgenol 2000; 174:1075–1078.

Cosgrove DO, Kedar RP, Bamber JC, et al. Breast diseases: Colour Doppler US in differential diagnosis. *Radiology* 1993; 189: 99-104.

Costantini, M., Belli, P., Ierardi, C., Franceschini, G., La Torre, G. and Bonomo, L. (2006). Characterization of solid breast masses. *Journal of Ultrasound in Medicine*. 25: 649-659

Gordon PB. US problem solving in Breast Imaging: Tricks of the Trade. RSNA categorical course in breast imaging. 1995; 121-31.

Dummin LJ, Cox M, Plant L (2007). Predication of breast tumor size by mammography and sonography- A breast screen experience . *The Breast*. 16: 38-46

Graf, O., Helbich, T., Fuchsjaeger, M., Hopf, G., Morgun, M., Graf, C., Mallek, R. and Sickles, E. (2004). Follow-up of Palpable Circumscribed Noncalcified Solid Breast Masses at Mammography and US: Can Biopsy Be Averted?1. *Radiology*, 233(3), pp.850-856.

Heywang-Kőbrunner, S., Dershaw, D. and Schreer, I. (2001). Diagnostic breast imaging. Stuttgart: Thieme.

Hieken, T., Harrison, J., Herreros, J. and Velasco, J. (2001). Correlating sonography, mammography, and pathology in the assessment of breast cancer size.*The American Journal of Surgery*, 182(4), pp.351-354.

Howard J. Using mammography for cancer control: an unrealized potential. Cancer. CA Cancer J Clin. 1987 Jan-Feb;37(1):33-48. This article on PubMed

Jackson VP. The role of US in Breast Imaging. *Radiology* 1990; 177: 305-11.

Kolb, T., Lichy, J. and Newhouse, J. (2002). Comparison of the Performance of Screening Mammography, Physical Examination, and Breast US and Evaluation of Factors that Influence Them: An Analysis of 27,825 Patient Evaluations1. *Radiology*, 225(1), pp.165-175

Kopan DB. Breast imaging. First Edition J. B. Lipincott Company. 1990; 227-47.

Lawrence RA and Lawrence RM. Breastfeeding: A Guide for the Medical Profession, 7th Ed. Elsevier Mosby, Maryland Hts, Missouri. 2011: pgs 8-11, 66-81, 100, 109-114, 117-124, 153-195, 319-335, 365-369, 381-390, 421-425, 553-560, 675, 750-909.

Lehman, C., Lee, C., Loving, V., Portillo, M., Peacock, S. and DeMartini, W. (2012). Accuracy and Value of Breast Ultrasound for Primary imaging Evaluation of Symptomatic Women 30-39 Years of Age.American *Journal of Roentgenology*, 199(5), pp.1169-1177.

Lister, D., Evans, A., Burrell, H., Blamey, R., Wilson, A., Pinder, S., Ellis, I., Elston, C. and Kollias, J. (1998). The accuracy of breast ultrasound in the evaluation of clinically benign discrete, symptomatic breast lumps. *Clinical Radiology*, 53(7), pp.490-492.

Madjar, H., Sauerbrei, W., Prömpeler, H., Wolfarth, R. and Gufler, H. (1997). Color Doppler and Duplex Flow Analysis for Classification of Breast Lesions. *Gynecologic Oncology*, 64(3), pp.392-403.

Marieb EN (1989). Human Anatomy and Physiology . *The Benjamin/ Cumming Publishing Company Inc, Califirnia*

Marugg, R., van der Mooren, M., Hendriks, J., Rolland, R. and Ruijs, S. (1997). Mammographic changes in postmenopausal women on hormonal replacement therapy. *Eur. Radiol.*, 7(5), pp.749-755.

Mendelson EB. The breast. In: Rumack CM, Wilson SR, Charboneau JW (eds) Diagnostic Ultrasound.2nd ed. St Louis, MO: CV Mosby Co; 1998:751–790.

Moore KL, Dalley AF, Agur AMR (2010). Clinically Oriented Anatomy.*6th Edition*, Lippencott Williams & Wilkins, Philadelphia.

Mubuuke AG, Kiguli-Malwadde E, Businge F, Byanyima R. Current knowledge, attitudes and practices of expectant women toward routine sonography in pregnancy at Naguru health center, Uganda. Pan African Medical Journal. 2009; 3: 18 This article on Pamj

Neville MC. Anatomy and Physiology of Lactation. Pediatric Clinics of North America. 2001: 48(1) 13-35.

Newton M and Newton NR. The let-down reflex in human lactation. J Pediatrics. 1948: 33;698-704

Nothacker, M., Duda, V., Hahn, M., Warm, M., Degenhardt, F., Madjar, H., Weinbrenner, S. and Albert, U. (2009). Early detection of breast cancer: benefits and risks of supplemental breast ultrasound in asymptomatic women with mammographically dense breast tissue. A systematic review. *BMC Cancer*, 9(1).

Nowak T , Handford AG (2004) . Pathophysiology : Concepts and Applications for Health-Care Professionals. 3rd Edition . McGraw-Hill, New York.

O'Rahilly R, Müller F. Basic human anatomy, a regional study of human structure. W B Saunders Co. (1983) ISBN:0721669905. Read it at google Books -Find it at Amazon

Pansky B. *Review of Gross Anatomy*. 6th ed. New York, NY: McGraw-Hill; 1996.

Paulinelli RR, Frwitas-Junior R , Moreira MA, Moraes VA, Bernardes-Junior JR, Vidal Cda S, Ruiz AN, Lucato MT (2005).Risk of malignancy in solid breast nodule according to their sonographic features. *Journal of Ultrasound in Medicine*. 24 (5) : 635-641

Pierie, J., Perre, C., Levert, L. and de Hooge, P. (1998). Clinical assessment, mammography and ultrasonography as methods of measuring the size of breast cancer: a comparison. *The Breast*, 7(5), pp.247-250.

Pritt, B. and Weaver, D. (2005). Accurate determination of breast cancer size: The role of histopathology and imaging.*Current Diagnostic Pathology*, 11(6), pp.435-442.

Rahbar G, Sie AC, Hansen GC, et al. Benign versus malignant solid breast masses: US differentiation.*Radiology* 1999;213:889–894.

Rumack CM, Wilson SR Charboneau JW (1998). Diagnostic Ultrasound . *2nd Edition, Mosby ,Missouri.*

Sehgal, C., Weinstein, S., Arger, P. and Conant, E. (2006). A Review of Breast Ultrasound. *J Mammary Gland Biol Neoplasia*, 11(2), pp.113-123.

Sickles EA, Filey RA, Callen PW. Benign breast lesions:Ultrasound detection and diagnosis. *Radiology* 1984; 151:467

Singh K , Azad T , Gupta GD (2008)The accuracy of ultrasound in diagnosis of palpable breast lumps . *Department of Sugery and Radilogy , Government Medical College , India*. 10 (4): 186-188.

Skaane P, Engedal K. Analysis of sonographic features in the differentiation of fibroadenoma and invasive ductal carcinoma. AJR Am J Roentgenol 1998;170:109–114.

Smallwood J, Khong Y, Boyd A, Guyer PB, Herbert A, Cooke T, Taylor I. An assessment of a scoring scheme for the preoperative diagnosis of breast lumps. Ann R CollSurg Engl1984; 66:251-7.

Stavros, A., Thickman, D., Rapp, C., Dennis, M., Parker, S. and Sisney, G. (1995). Solid breast nodules: use of sonography to distinguish between benign and malignant lesions. *Radiology*, 196(1), pp.123-134.

Tabar L, Pentek Z, Dean PB. The diagnostic and therapeutic value of breast cyst puncture and pneumocystography. *Radiology*. 1981; 141:659-663. This article on PubMed

Tardivon, A., Guinebretière, J., Dromain, C. and Vanel, D. (2002). Imaging and management of nonpalpable lesions of the breast. *European Journal of Radiology*, 42(1), pp.2-9

Taylor, K., Merritt, C., Piccoli, C., Schmidt, R., Rouse, G., Fornage, B., Rubin, E., Georgian-Smith, D., Winsberg, F., Goldberg, B. and Mendelson, E. (2002). Ultrasound as a complement to mammography and breast examination to characterize breast masses. *Ultrasound in Medicine & Biology*, 28(1), pp.19-26.

Tohno E, Cosgrove DO, Sloane J. Ultrasound diagnosis of breast disease. First Edition. Churchill Livingstone. Edinburgh, London, adrid, Melbourne, New York, Tokyo. 1994; 23-70.

Weinstein SP , Conant EF , Mies C , Acs G, Lee S, Seghal C (2004) .Posterior acoustic shadowing in benign breast lesion : sonographic – pathologic correlation. *Journal of Ultrasound in Medicine.* 23 (1): 73-83

www.accessmedicine.net

www.medscape.com

www.mybreast.org