

## Combined mammographic and sonographic evaluation of breast masses

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### Abstract

**Aims and Objectives:** To evaluate the role of combined mammographic and sonomammographic imaging in patients with breast masses.

**Materials and Methods:** The study done over a period of 18 months, included 60 female patients aged 30 or above with breast masses who underwent combined mammographic and sonomammographic evaluation.

**Results:** 24 (40%) of the 60 palpable abnormalities were benign and 14 (58.3%) of these benign lesions were visible both on mammography and sonography. 8 (33.3%) of the 24 benign lesions were mammographically occult and identified at sonographic evaluation only. 2 (8.3%) lesions were sonographically occult and visualized on mammography alone. In 9 (15%) of the 60 cases, imaging evaluation resulted in a suspicious assessment for malignancy and all these lesions underwent biopsy and 3(33.3%) were diagnosed as having malignancy and 6 (55.5%) cases were benign. 28 (45%) of the 60 abnormalities had negative imaging assessment finding. Of these 10 (37.03%) patients underwent biopsy on basis of very strong clinical suspicion(positive family history etc)and all of them were benign. The sensitivity and negative predictive value for combined mammographic and sonomammographic assessment were 100%; the specificity was 80.1%.

**Conclusion:** Malignancy was detected in 3 of the 60 women who underwent combined imaging for breast abnormalities. Combined mammographic and sonomammographic assessment was shown to be very helpful in identifying benign as well as malignant lesions causing abnormalities of the breast.

**Keywords:** Biopsy, breast, mammography, palpable lumps, sonomammography

### Introduction

Breasts are a secondary sexual characteristic in females. They are also the source of nutrition for the neonate and thus of mankind. They are also present in a rudimentary form in males. This tender, sensitive and delicate complex structure is constantly under the influence of hormones.

The breast develops from mammary ridges. After menarche, the young virgin breast contains denser connective tissue. With progression in age the dense breast becomes mixed glandular pattern tissue, and with further progression in age, breast begins to involute into fatty tissue. Any aberration in this process leads to the susceptibility to a

spectrum of localised pathologies like, hyperplastic and neoplastic changes. Of the various pathologies that afflict the breast, malignancy is often encountered and most dreaded. Breast cancer is the leading cause of non-preventable cancer deaths among women. Great strides in early detection and improved treatment have decreased breast cancer related deaths.

A palpable mass in a woman's breast represents a potentially serious lesion and requires evaluation by history taking, physical examination and mammography.

Mammography is a well-defined and widely accepted technique to evaluate clinically suspected breast lesions and screening for breast cancer. In these patients, sonomammography is a useful adjunctive modality and helps characterizing a mammographically detected palpable abnormality, especially in patients with dense breast.

Sensitivity and specificity of sonography or mammography is higher if sonography and mammography are combined.

**Materials and methods**

The study was conducted at Department of Radiodiagnosis, Katuri Medical College and Hospital. The study included women more than or equal to 30 years referred to this centre with abnormalities of breast during a period of 18 months between January 2011 and June 2012 to evaluate its role in the management of palpable abnormalities of the breast.

The abnormalities of the breast included in the study had a variety of clinical descriptions, such as palpable lump, thickening, nodularity etc. In all patients studied, the abnormalities were of sufficient clinical concern to be referred for imaging evaluation.

The following information was documented at the time of initial visit- date of initial visit, age of the patient, site of the palpable abnormality and description of the abnormality. All patients underwent

diagnostic mammography, which included standard cranio-caudal and medial - lateral - oblique views. Later all the patients were subjected to sonography of breast.

Mammography was performed with GE SENOGRAPHE DMR equipment.

Sonographic examination was performed using a 7- 10 MHz transducer of PHILIPS EnVISOR C 0.2 machine.

**Exclusion criteria**

- Women below 30 years of age with palpable abnormalities of breast.
- Women with fungating mass per breast and mass adherent to chest wall, where performing mammography was difficult.

Based on the imaging findings the final reporting was done as per BI-RADS reporting system.

Radiologists are encouraged to use in their reporting, the terms recommended in the BI-RADS (Breast Imaging-Reporting And Data System) published by the ACR.

**Table 1: BI-RADS Classification**

Categories	
<b>Category I</b>	Normal mammogram. Probability of breast cancer 0%
<b>Category II</b>	Focal benign findings for which nothing further is required. Probability of breast cancer 0%
<b>Category III</b>	Probably benign finding, short interval follow up suggested. Probability of breast cancer < 2%.
<b>Category IV</b>	Indeterminate lesion, biopsy recommended. Probability of breast cancer 30%(Between 2 & 90%).
<b>Category V</b>	Highly suggestive of malignancy and requires biopsy. Probability of breast cancer > 90%.
<b>Category VI</b>	Histologically verified cancer. Initial therapeutic procedures.

**Observations and results**

A total 60 patients with abnormalities of the breast who underwent combined mammographic and sonomammographic evaluation. The breast abnormalities were reported in 29 patients in the right breast and 24 patients in the left breast and 7 patients on both sides.

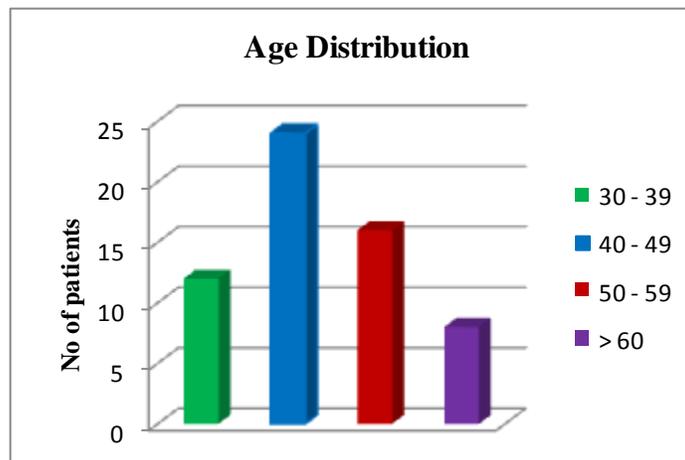
In 9 of the 60 cases, imaging evaluation resulted in a recommendation for surgical consultation based on a combination of mammographic and sonomammographic features. All of these 9 lesions underwent

biopsy, 4 excisional biopsy and 5 FNAC. Of these 9 patients 3 were diagnosed as malignant and 6 were benign pathologically. 10 patients underwent biopsy despite negative findings because of high degree of clinical suggestion and in each case the histological diagnosis was benign.

The positive predictive value for cancer lesions undergoing biopsy that showed questionable findings on combined mammographic and sonomammographic evaluation undergoing biopsy was 33.33%.

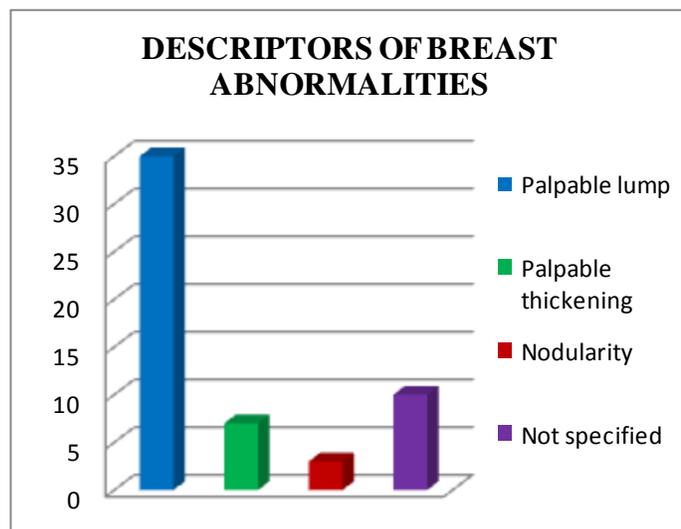
**Table 2, Figure 1: Age distribution of patients**

PATIENT'S AGE GROUPS	No. of patients
30- 39	12
40-49	24
50-59	16
>60	8
<b>Total</b>	<b>60</b>



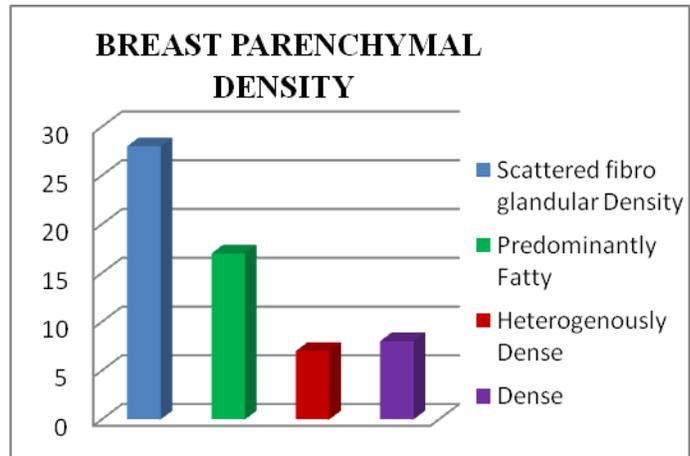
**Table 3, Figure 2: Descriptors of breast abnormalities**

DESCRIPTOR	No. of patients
Palpable lump	35
Palpable thickening	7
Nodularity	3
Not specified	15
<b>Total</b>	<b>60</b>



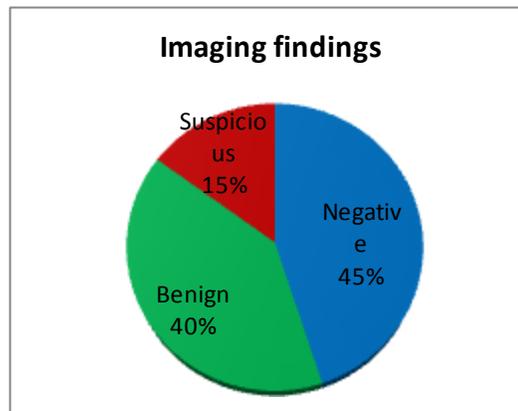
**Table 4, Figure 3: Mammographic tissue density in the patients studied**

BREAST PARENCHYMAL DENSITY	No. of patients
Scattered fibro glandular density	28
Predominantly Fatty	17
Heterogenously Dense	7
Dense	8
<b>Total</b>	<b>60</b>



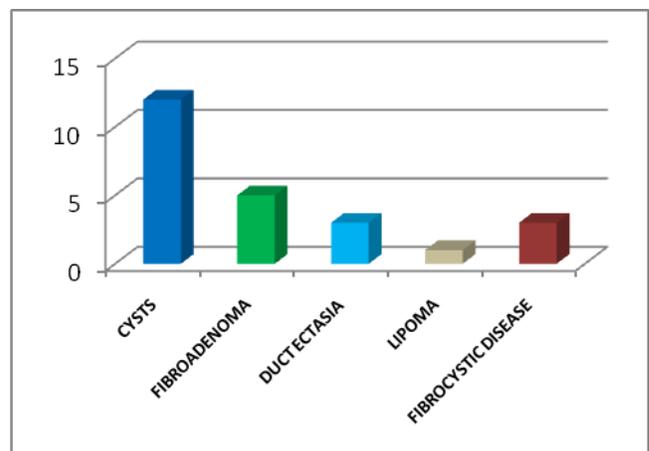
**Table 5, Figure 4: Final assessment after combined mammographic and sonographic evaluation of breast abnormalities in 60 patients**

Imaging findings	No. Of Breast Abnormalities
Negative	27
Benign	24
Suspicious	9
<b>Total</b>	<b>60</b>



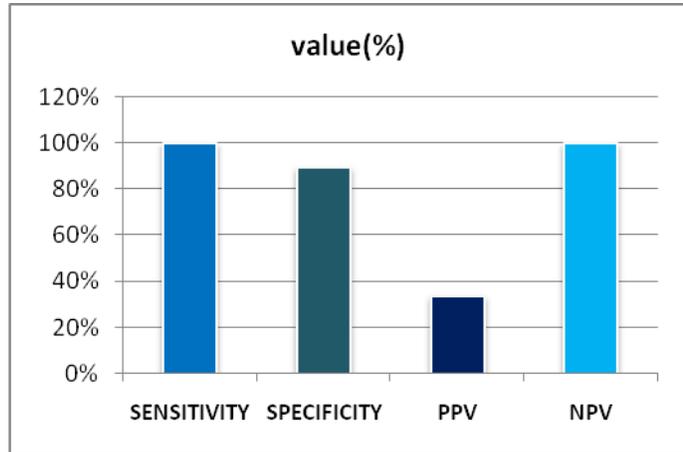
**Table 6, Figure 5 : Benign causes of breast abnormalities including cysts**

BENIGN LESIONS	NO.OF ABNORMALITIES
CYSTS	12
FIBROADENOMA	5
DUCT ECTASIA	3
LIPOMA	1
FIBROCYSTIC DISEASE	3



**Table7, Figure 6: Test characteristics for combined mammographic and sonographic evaluation in 60 patients with abnormalities of breast.**

CHARACTERISTICS	VALUE %
Sensitivity	100%
Specificity	89.47%
Positive predictive value (PPV)	33.33%
Negative predictive value (NPV)	100%



**Discussion**

The various benign and malignant breast lesions and their imaging characteristics are as follows:

**Benign lesions**

**Table 8:**

BENIGN LESIONS			
	AGE GROUP	MAMMOGRAM	ULTRASOUND
<b>FIBROADENOMA</b> (Giant fibroadenomas are fibroadenomas that are 8 cms or larger)	young	Oval or lobular equal <sup>[3]</sup> density mass with smooth margins. Popcorn like calcifications may develop at the periphery	Oval, well circumscribed homogenous masses, usually wider than tall with up to four gentle lobulations
<b>PHYLLODES TUMOUR</b>	5th decade	Dense, round or oval, lobulated non calcified mass with smooth borders	Smoothly marginated inhomogenous mass that occasionally contains cystic spaces producing acoustic posterior enhancement.
<b>FIBROCYSTIC DISEASE</b>	Premenopausal women between 20 and 50 years of age	May be multifocal and bilateral USG- extremely variable since it depends on the stage and extent of morphological changes. may be normal or may be focal areas of thickening of the	

		parenchyma, with or without patchy increase in echogenicity or discrete single cysts or clusters of small cysts may be seen in some. Focal fibrocystic changes may appear as solid masses or thin-walled cysts.	
<b>CYSTS</b>	35 to 50 years	Cannot reliably be distinguished from solid masses by mammography	<p><b>Simple cyst</b>-Anechoic with posterior acoustic enhancement.</p> <p><b>Complex</b><sup>[6,14]</sup> (or complicated or atypical) cyst : characterized by internal echoes or thin septations, thickened and/or irregular wall and absent posterior enhancement.</p> <p><b>Intracystic mass/ intracystic nodule</b> should be regarded as "suspicious for neoplasm" and managed as solid lesions.</p>
<p><b>PAPILLOMA:</b>            Either solitary or multiple.            Solitary papillomas are central or peripheral.            Peripheral papillomas are considered a risk factor for breast cancer.</p>	-	Often not seen on mammography or ultrasound at all	When seen on ultrasound, papillomas are solid round or oval or microlobulated hypoechoic masses.
<b>LACTATING ADENOMAS</b>	Young patients in the second or third trimester. May regress in size in the post partum period.	Solid well circumscribed masses that can enlarge rapidly during pregnancy	Oval or lobular and smoothly margined and can contain cystic or necrotic spaces
<b>RADIAL SCAR:</b> (Larger variants are called complex sclerosing lesions)		Spiculated mass with either dark or white central area .A radial scar has a central portion that undergoes atrophy, thereby resulting in a scar-like formation, pulling in of the surrounding glandular	Hypoechoic mass, with or without acoustic shadow.

		tissue produces a spiculated mass.	
<b>HAMARTOMA:</b> Also known as fibroadenolipoma or lipofibroadenoma or adenolipoma, Clinically hamartoma presents as a discrete, encapsulated, painless mass <sup>[5]</sup> .		The classic mammographic appearance is a circumscribed area consisting of both soft tissue and lipomatous elements, surrounded by a thin radiolucent zone	
<b>GALACTOCOELE</b>	During lactation or shortly after breast feeding is stopped	galactocoeles may appear as an intermediate mass , unless the classic fat fluid level is seen .	US may show a complex mass.
<b>ADENOSIS:</b> A proliferative lesion that is characterized by an increased number or size of glandular components, mostly involving the lobular units. Various types of adenosis have been described, of which sclerosing adenosis and microglandular adenosis are important.			
<b>Sclerosing adenosis</b>		<b>Microglandular adenosis</b>	
<ul style="list-style-type: none"> <li>• Palpable mass or as a suspicious finding at mammography.</li> <li>• Can coexist with both invasive and in situ cancers.</li> <li>• Risk factor for invasive<sup>[7]</sup> breast cancer</li> </ul>		<ul style="list-style-type: none"> <li>• Although considered benign, there is some evidence of the potential of this lesion to become invasive carcinoma.</li> <li>• Has a tendency to recur if not completely excised</li> </ul>	
<b>LIPOMA</b> <sup>[9]</sup>			
<ul style="list-style-type: none"> <li>• Usually solitary tumor composed of mature fat cells.</li> <li>• Usually both mammography and ultrasound scanning give negative results, unless the tumor is large.</li> <li>• If the diagnosis of lipoma is confirmed the patient is normally followed through palpation after 6 months.</li> <li>• However, if the diagnosis is not certain or the lesion grows rapidly, the tumor should be surgically removed.</li> </ul>			
<b>LYMPHNODE:</b>			
<ul style="list-style-type: none"> <li>• An intramammary lymphnode is often situated in the upper quadrant of breast.</li> <li>• A hilar notch or fatty hilum should be visible to make the diagnosis .</li> <li>• Normal intramammary lymphnodes are usually less than 1 cm in diameter.</li> <li>• A non pathologically enlarged lymphnode in the axilla may vary in size depending on the size of the fatty hilum.</li> </ul>			
<b>FAT NECROSIS:</b>			
<ul style="list-style-type: none"> <li>• Fat necrosis is due to saponification of fat from previous trauma, usually surgery or blunt trauma.</li> <li>• On mammography, fat necrosis typically contains a fatty lipid center and is round in shape, but it occasionally has a spiculated appearance.</li> </ul>			

**Inflammatory and related conditions****Mastitis**

A variety of inflammatory and reactive changes can be seen in the breast. Inflammatory breast cancer, as the name suggests, mimics an infectious or inflammatory etiology. It often develops without a palpable mass lesion and is often initially misdiagnosed. Mammographic and sonographic evaluation is helpful in establishing the diagnosis. Image-guided biopsy of the abnormal breast parenchyma or skin biopsy confirms the diagnosis.

**Acute mastitis:**

Acute mastitis usually occurs during the first 3 months postpartum as a result of breast feeding. Also known as puerperal or lactation mastitis<sup>[2]</sup>, this disorder is a cellulitis of the interlobular connective tissue within the mammary gland, which can result in abscess formation and septicemia. It is diagnosed based on clinical symptoms and signs indicating inflammation. Suitable patients assessed by ultrasonography can be treated without surgery by needle aspiration and antibiotics with excellent cosmesis.

**Granulomatous mastitis:**

Granulomatous reactions<sup>[4]</sup> resulting from an infectious etiology, foreign material or systemic autoimmune diseases such as Sarcoidosis and Wegener's Granulomatosis can involve the breast.

- Identification of the etiology requires microbiologic and immunologic testing in addition to the histopathologic evaluation. granulomatous mastitis.
- Tuberculosis of the breast is a very rare disease. However, both clinical and radiological features of tuberculous mastitis are not diagnostic and easily can be confused with either breast cancer or pyogenic breast abscess by clinicians. Definitive diagnosis of the disease is based on identification of typical histological features and mycobacterial culture.

**Mammary duct ectasia:**

- Also called periductal mastitis
- Can mimic invasive carcinoma clinically.
- It is a disease of primarily middle-aged to elderly parous women,
- Usually an asymptomatic lesion
- Is detected mammographically because of microcalcifications.

Breast carcinoma has been reported in only 5% of patients with breast symptoms, and even among palpable lesions undergoing biopsy, a large number of lesions turned out to be benign. The role of mammography in patients with palpable breast lumps is to show a benign cause for breast abnormality and to avoid further intervention, and to support earlier intervention in case a mass has malignant features, screen the remainder of the ipsilateral and contra lateral breast for additional lesions, and to assess the extent of malignancy when it is diagnosed.

However the false negative rate of mammography for breast cancer in patients with abnormalities of the breasts has been reported to be as high as 16.5 %. Multiple studies have shown that the false negative rate for a combined mammographic and sonographic evaluation reduces to 0% to 2.6%. Additional imaging with sonography is appropriate in most instances, with the exception of lesions that are mammographically benign as noted above or lesions that are highly indicative of malignancy, in which sonographic imaging would not add any additional information. Sonography may decrease the need for intervention by showing benign causes of palpable abnormalities such as cysts, benign intramammary lymphnodes, extravasated silicon and superficial thrombophlebitis of Mondor disease of the breast.

<b>BREAST CANCER</b>
<p><b>Risk factors</b></p> <p>Sex (being a woman), Aging, Inherited genetic susceptibility, Family history of breast cancer in a first-degree relative, Breast exposure to high doses of radiation during breast development, Atypical hyperplasia or lobular neoplasia found on a breast biopsy, Other family history of breast cancer (non first-degree relative), Early menarche, Late menopause, Nulliparity, Late first full-term pregnancy (after age 30) .</p>
<p><b>Carcinoma in situ:</b></p> <ul style="list-style-type: none"> <li>• No mammographic finding characteristic of lobular carcinoma insitu. It cannot be distinguished from benign changes or normal breast parenchyma.</li> <li>• Ductal carcinoma in situ may have varied mammographic manifestations with calcifications being the most common. Other manifestations include soft-tissue opacity either with or without associated calcifications.</li> </ul>
<p><b>Paget's disease:</b></p> <ul style="list-style-type: none"> <li>• It is a benign appearing eczematoid lesion of the nipple caused by large malignant cells (paget's cells) which arise from the ducts and which invade the surrounding nipple epithelium. Mammographic findings include only calcifications in 72%, soft tissue abnormality with calcifications in 12%, only soft tissue abnormality in 10%.</li> </ul>
<p><b>Invasive ductal carcinoma:</b></p> <ul style="list-style-type: none"> <li>• It is the most common breast cancer and accounts for about 90% of all cancers.</li> <li>• A classical appearance is a dense irregular or spiculated mass that occasionally contains pleomorphic calcifications representing DCIS.</li> <li>• Spiculated masses on the mammogram may be round, irregular. Spiculation represents either productive fibrosis or tumour extension.</li> </ul>

In this study, 24 (40%) of the 60 lesions were categorized as benign after a combined mammographic and sonographic evaluation, clearly showing the value of imaging in helping to avoid unnecessary biopsies. In these patients sonography was able to categorise palpable lesions obscured by dense tissue on mammograms. Moss et al<sup>[10]</sup> reported that sonography increased cancer detection by 14% in symptomatic patients who were evaluated with both mammography and sonography. . In a study of 411 palpable abnormalities by Shetty MK and Shah YP<sup>[13]</sup> 66(16%) of the 165 palpable abnormalities were mammographically occult. In this study 2 lesion (fat necrosis) were sonographically occult and was visualized only on mammography. In our study 8(13.33%) of the 60 lesions were mammographically

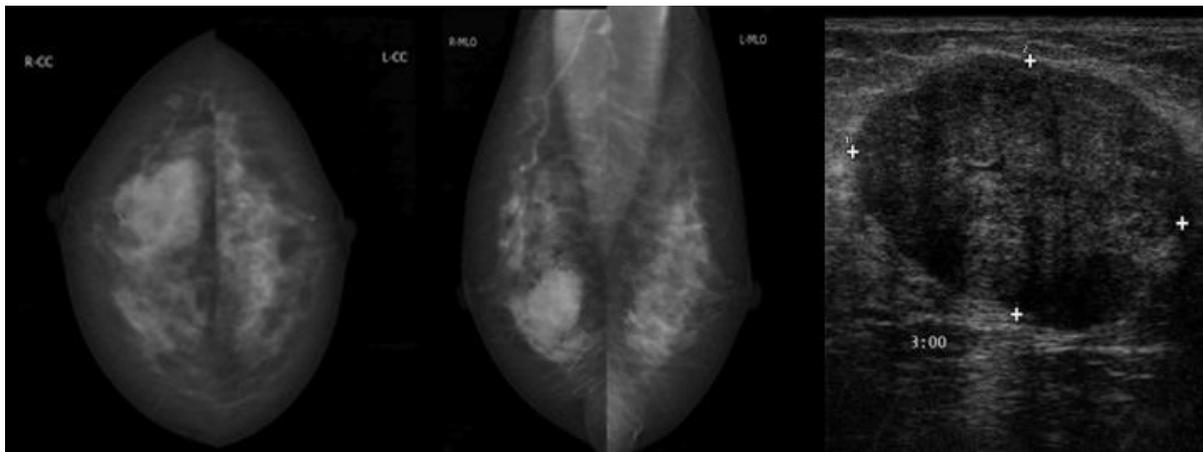
occult and were seen only on ultrasound. Of these 6 were benign cysts and 1 was duct ectasia. Sonography, therefore, is complimentary to mammography in patients with palpable abnormalities; its superiority over mammography is in being able to show lesions obscured by dense breast tissue and in characterizing palpable lesions that are mammographically not visible or occult. Mammography is complimentary to sonography because of its ability to screen the remainder of the ipsilateral and contra lateral breast for clinically occult lesions. It has been reported that the accuracy of sonography is comparable with that of mammography as a screening modality for breast cancer. However the role of sonographic screening for additional lesions in the symptomatic patients has not been reported.

Combined imaging evaluation reduce reported that only 11.1% of 623 excisional biopsy specimens of palpable breast revealed carcinoma. In this study only 9 (15 %)of the 60 palpable abnormalities underwent biopsy on the basis of imaging findings and only 3(5 %) showed malignancy.

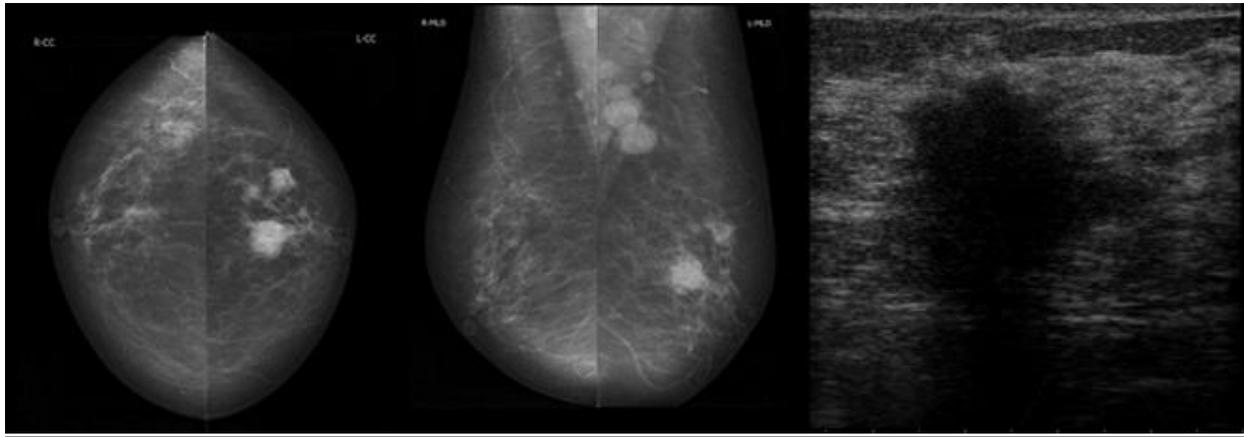
In a review article, Donegan stated that most of the breast cancers appear as palpable masses, usually found by the patient<sup>[3]</sup>. However, not all palpable abnormalities represent discrete masses. This is especially true in women younger than 40 yrs in whom normal glandular nodularity may be mistaken for dominant masses. In this study of 60 patients who presented with breast abnormalities 27 patients showed negative findings on both combined mammographic and sonographic examination. 9 of these patients underwent biopsy on the grounds of clinical suspicion and all were benign.

unnecessary biopsies. Perdue<sup>[12]</sup> et al A small number of palpable masses detected on physical examination are malignant; in this study 5 % of the palpable lesions that underwent combined mammographic and sonographic imaging were malignant, compared with 8% in a series of 123 cases of palpable breast thickening reported by Kaiser et al<sup>[8]</sup>, 7% in 605 patients younger than 40 years reported by Morrow et al<sup>[11]</sup>. The value of combined mammographic and sonographic imaging in symptomatic patients has been studied previously. Moss et al reported sensitivity of 94.2% and specificity of 67.9% in 368 patients<sup>[10]</sup>. Shetty MK and Shah YP reported a sensitivity of 100% and specificity of 80.1%<sup>[13]</sup>. Barlow et al reported a sensitive of 87% and specificity of 88% and positive predictive value of 22 %<sup>[1]</sup>. Their findings are comparable with present findings of sensitivity of 100 % and specificity of 84.3% in patients with breast masses.

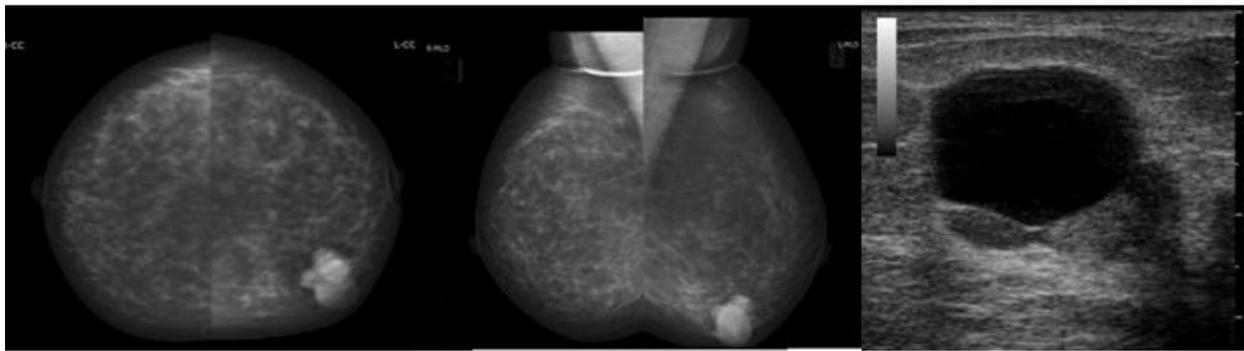
## IMAGES



**Figure 7:** Bilateral Mammography (CC&MLO views) showing a posteriorly well-defined, anteriorly obscured lobulated mass with no architectural distortion in the right breast retroareolar region. High resolution Ultrasound shows the mass to be solid and to have benign features. It is well circumscribed, hypoechoic, and oval. There is a thin echogenic pseudocapsule surrounding the mass. BIRADS 2 category. IMPRESSION : FIBROADENOMA in right breast.



**Figure 8:** Bilateral Mammography CC and MLO views showing two irregular masses with spiculated margins in retro areolar region of left breast. Extensive lymphadenopathy noted in axilla. Opposite breast appears normal. On high resolution Ultrasound, the mass is intensely hypoechoic, taller than wide, & margins are microlobulated, irregular with posterior acoustic shadowing in left breast. S/O **BIRADS 5** category



**Figure 9:** Bilateral Mammography CC&MLO views shows a round hyperdense, well circumscribed lobulated mass in the left breast. High resolution ultrasound shows the round mass to be a cyst with thick intact wall containing low-level echoes and solid component in the wall suggesting a complex cyst. S/O **BIRADS 3** lesion. Cyst contents & solid portion were biopsied & found to be of benign nature.

### Conclusion

Combined use of mammography and sonography plays an important role in the management of breast lesions. Its applications are

- Characterizes the mass.

- Avoids unnecessary interventions in which imaging findings are unequivocally benign.
- Negative findings on combined mammographic and sonomammographic imaging have very high specificity and are reassuring to the patient.

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