

**Original article:**

**DIAGNOSTIC EFFICACY OF COMBINED MAMMOGRAPHY AND ULTRASONOGRAPHY IN EVALUATION OF BREAST LESIONS WITH PATHOLOGICAL CORRELATION AND BIRADS ASSESSMENT**

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**ABSTRACT**

**BACKGROUND:** A common cause of cancer death in post - menopausal women and younger women is breast carcinoma. The routinely used modalities in the evaluation of breast lesions are mammography and ultrasonography.

**AIM:** To find the sensitivity, specificity and accuracy of mammography, ultrasonography and by combining both the modalities. To identify the effectiveness of the BI-RADS-mammogram and Ultrasound for differentiation of benign and malignant lesions with histopathological findings.

**METHODOLOGY:** A prospective study was conducted in 55 patients at SLIMS, Puducherry. Women referred to the Department of Radiodiagnosis, for a screening mammogram, and breast complaints were subjected to mammography and ultrasonography after a brief history and clinical examination. Imaging findings were assessed with BIRADS mammogram and ultrasound descriptors and correlated with histopathology.

**RESULTS & CONCLUSION:** The sensitivity, specificity and accuracy of mammography were (96% ,80%, 94.5% respectively) ultrasonography were (96% 96%,96.3% respectively) and by combining both the modalities (97.8% 100% ,98.1% ) respectively. According to BI-RADS Mammogram shape, margin, calcification, associated features showed statistically significant p-values ( $p < 0.002$ ,  $p = 0.005$ ,  $p = 0.0034$ , and  $p = 0.0207$ , respectively) and BI-RADS Ultrasound showed statistically significant p-values for shape, margin, echo pattern, orientation, posterior acoustic shadowing ( $p = 0.0001$ ,  $p = 0.0001$ ,  $p < 0.0001$ ,  $p < 0.0142$ ,  $p = 0.0002$  respectively) with 95% confidence interval for differentiating benign and malignant lesions. This study confirms that combined mammography and ultrasonography in detection of breast lesions has more sensitivity, specificity, and accuracy than a single modality in detecting breast lesions. The BI-RADS mammogram and ultrasound are useful for categorization of lesions into benign and malignant breast lesions.

**Keywords :** Mammography, Ultrasonography, BIRADS

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**INTRODUCTION**

Breast carcinoma is a common cause of cancer death in women and comes 5th after lung, stomach, colon and liver cancer.<sup>[1]</sup> Post - menopausal women and younger women are more prone to develop breast cancer. Palpable lesions are common presenting

complaints of the breast.<sup>[2]</sup> Mostly they are benign but needs evaluation to rule out malignancy.

Mammography and ultrasonography are the routinely used modalities in the evaluation of breast lesions. Ultrasonography is appropriate modality in the evaluation of a woman younger than 30 years and also helpful in the evaluation abnormalities not seen

mammographically.<sup>[3]</sup> It is especially useful in the evaluation of dense breasts which is a limitation of mammography

Mammography and ultrasonography have got good accuracy rate in diagnosing breast lesions but we find sensitivity and specificity in detection of breast lesions seem to increase by using both the imaging modalities together. Histopathological examination helps us to confirm the findings of mammography and ultrasonography of the breast.

The National Cancer Institute and American College of Radiology (ACR) recommends that all women of age >40 years must undergo screening mammography for every 2 years. Women aged 50 and above should undergo a screening mammography every year. Women <40 years with a family history or a genetic predisposition to breast cancer must undergo screening mammography.<sup>[4]</sup>

This study is a prospective analysis of 55 patients with breast complaints and was carried out to provide a systematic and practical approach for evaluation of breast masses.

#### **AIMS AND OBJECTIVES:**

- To assess the sensitivity, specificity, and accuracy of mammography and ultrasonography and to identify the effectiveness of the BI-RADS-mammography and BI-RADS-ultrasound descriptors for differentiation of benign and malignant lesions of the breast with histopathological findings.
- To assess the improvement in accuracy of diagnosis while combining both modalities and comparing with the gold standard histopathology/cytology.

#### **MATERIALS AND METHODS:**

A prospective study was conducted in 55 patients at SLIMS, Puducherry. Women referred to the Department of Radiodiagnosis, for a screening mammogram, breast complaints and with clinical suspicion of breast lesions, were included in the study for ultrasonography with mammography and histopathology. This study was approved by the Institutional and University ethics board before its execution.

All adult female patients with age > 30 years, women undergoing screening mammography and ultrasonography, patients with breast complaints of a palpable mass, pain, discharge and with clinical suspicion of breast disease were included in the study. Women <30 yrs, patients who do not give consent for FNAC, patients with bleeding diathesis, pregnant and lactating women, women with breast implants, male patients were excluded in the study.

Mammogram (MG) was done in GE DMR SENOGRAPH ZF000DMR. USG was performed on SONIX OPQ<sup>+</sup>-Color Doppler ultrasound and TOSHIBA NEMIO XG SSA-580A, real-time scanner with a handheld linear electronic array transducer of frequency 7.5 MHz.

#### **IMAGING AND STATISTICAL ANALYSIS:**

A group of 55 female patients with complaints of pain, discharge, and lump, with clinical suspicion of breast lesions and those who come for screening, were subjected to both MG and USG after taking a detailed history and informed consent.

Bilateral breast mammogram (MG) was performed and each subject was evaluated with a mediolateral oblique (MLO) and craniocaudal (CC) views. Additional views like compression / magnification view have been taken in some cases for better visualization of the lesion. Bilateral breast

sonography was performed and images were acquired in both transverse radial planes and doppler was done to see for vascularity of the lesions. US-guided FNAC was performed in few cases by using an 18- or 20-gauge needle and excision surgery was performed in rest of the cases. Coagulation profile was checked before the procedure. Then, lesions were categorized according to BI-RADS mammogram and BI-RADS-ultrasound descriptors.

The imaging findings were analyzed according to the BI-RADS-mammogram and ultrasound descriptors by 2 radiologists with 5 years and 2 years of experience in performing and interpreting breast MG and USG. The findings have been documented in the master chart and statistical analyses have been

done. In patients with multiple lesions, the most dominant lesion was evaluated.

Data collected was entered into MS excel spreadsheet and analysis conducted using a SPSS statistical package. Percentage and proportions have been applied to assess covariates like age group, the presence of lump and pain, side of complaint.

The sensitivity, specificity, positive predictive value, negative predictive value, accuracy for the detection of breast lesions by mammography, ultrasonography and for combined approach was evaluated.

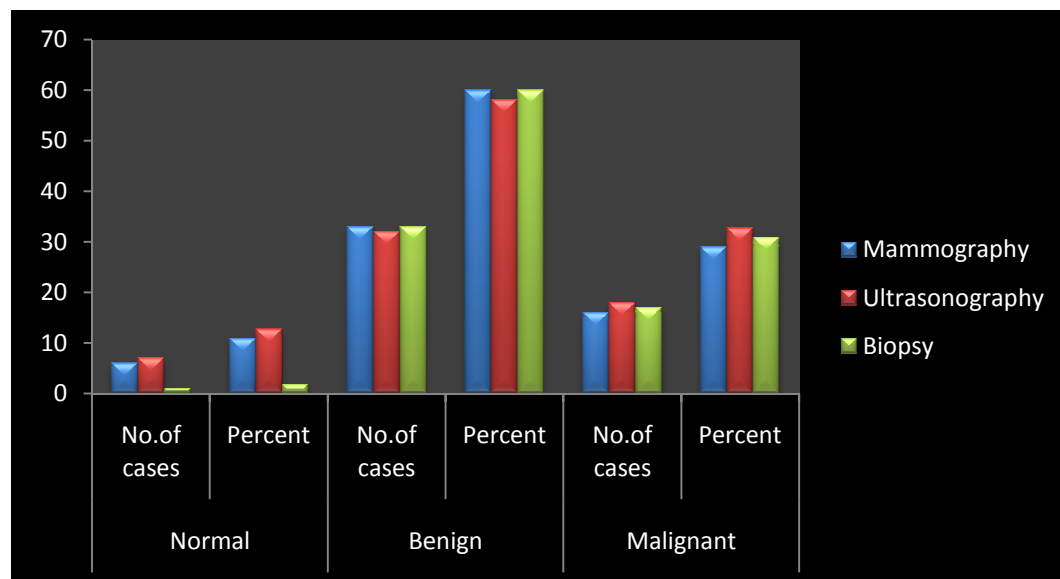
The lesion was characterized using BI-RADS mammography and ultrasound descriptors and P value was calculated for all these descriptors. A P value less than 0.05 was considered statistically significant.

**OBSERVATIONS & RESULTS:**

**Table 1:** Percentage distribution of the sample according to diagnosis

Diagnosis	Normal		Benign		Malignant	
	No.of cases	Percent	No.of cases	Percent	No.of cases	Percent
Mammography	6	10.9	33	60	16	29
Ultrasonography	5	9.0	32	58.1	18	32.7
Biopsy	1	1.8	33	60	17	30.9

**Chart 1:** Bar chart showing the percentage distribution of the sample according to diagnosis

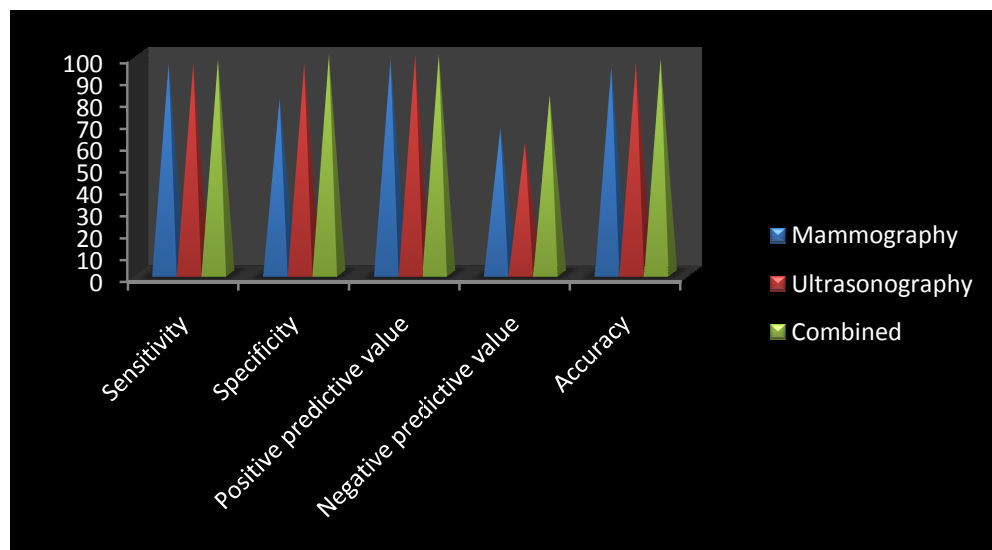


**Table 2:** Analysis, test characteristics and diagnostic accuracy of mammography, ultrasonography, and combined approach

	<b>Mammography</b>	<b>Ultrasonography</b>	<b>Combined</b>
Sensitivity	96%	96%	97.8%
Specificity	80%	96%	100%
Positive predictive value	97.96	100	100
Negative predictive value	66.6	60	81.59
Positive likelihood ratio	4.8	-	-
Negative likelihood ratio	0.05	0.04	0.08
Accuracy	94.5%	96.3%	98.1%



**Chart 2:** Bar chart showing analysis, test characteristics and diagnostic accuracy of mammography, ultrasonography, and combined approach



**DISCUSSION:**

Breast cancer is one of the most common malignancies worldwide. In the absence of a known preventable cause of breast cancer, the single most important factor in reducing death from breast cancer is early detection through screening. Improved screening has allowed detection of more early-stage breast cancers.<sup>[5]</sup> Thus mammography and ultrasonography play a major role.

This prospective study was conducted in 55 patients suspected to have breast pathology and were subjected to Mammography, Ultrasonography and pathological correlation (FNAC/HPE) was obtained.

**CLINICAL DATA:**

In our study, the larger group of people was aged between 30-49 yrs representing 74.5%. Patients of 50-59 yrs comprised 16.3% and of age greater than or equal to 60 constituted 6%.

In this study, 85.45% presented with lump and 14.5% had no complaints of lump. 50.9% had complaints on

left side, 30.9% on right side and bilaterally 18.18%. Out of 55 patients, 58.18 % presented with pain and 41.81% had no complaints of pain.

**MAMMOGRAPHY:**

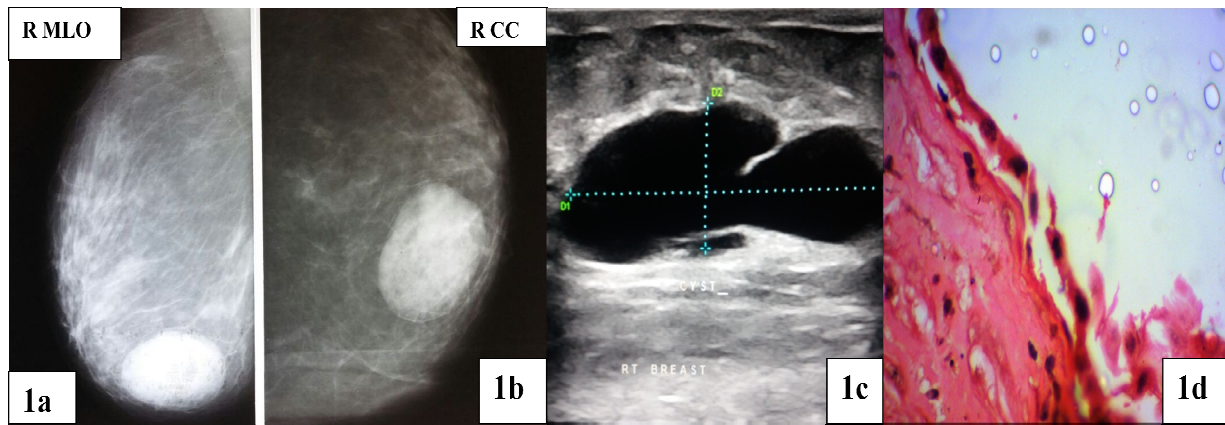
Mammography is the desired screening examination for breast. In the presence of malignancy, the most common abnormality seen at mammography is microcalcifications.<sup>[6]</sup> Also, it is widely available, well tolerated and inexpensive.

Diagnostic mammography is commonly used to identify possible breast cancers in women with signs or symptoms of the disease. Diagnostic mammography usually has better performance over screening mammography, because the presence of symptoms or clinical findings may locate a tumor of advanced stage easily.<sup>[7]</sup>

We performed a prospective study of 55 women coming for a screening mammogram and for a diagnostic mammogram with signs or symptoms of breast cancer of age >30 yrs.

In this study, mammography showed that 33(60%) patients had features of benign lesion and 29% had features of malignancy and 6(10.9%) cases were normal. HPE revealed 60% of the lesion to be benign and 30.9% malignant. The specificity, sensitivity, and accuracy of mammography were 80, 96%, and 94.5% respectively. The positive and negative predictive values were 97.9 and 66.6. Biopsy was not done in 4 cases since mammogram and ultrasound showed no

abnormalities. Mammogram was not a good technique in picking up the cystic lesions since all were seen as a hyperdense mass and could not be differentiated from solid lesions. All benign lesions were identified on mammogram and one malignant lesion was missed on mammogram.



**Figure 1(a-d):** Mammogram shows (a,b) a well-defined, oval, hyperdense lesion with no calcification. Use of another patient shows (c,d) a large well-defined, lobulated, anechoic lesion, parallel in orientation to the skin with no septations or echogenic debris with HPE of the same patient showing a cyst with apocrine cell lining.

Gurung G et al in his study concluded that out of 100 patients 65% had features of a benign lesion and 35% had features of malignancy on mammography. Pathology revealed 64% of the lesion to be benign and 36% to be malignant. There were four false negative (6.2%) and three false positive (8.6%) cases. The sensitivity and specificity of mammography were 88.9% and 95.3% respectively. [8]

**ULTRASOUND:**

Breast cancer detection has widely been improved after high-resolution ultrasound equipment was found. In the past, ultrasound was only considered useful for the diagnosis of cysts. [9] Later ultrasound was started being used for guided interventional, local preoperative staging and diagnosis etc. In dense

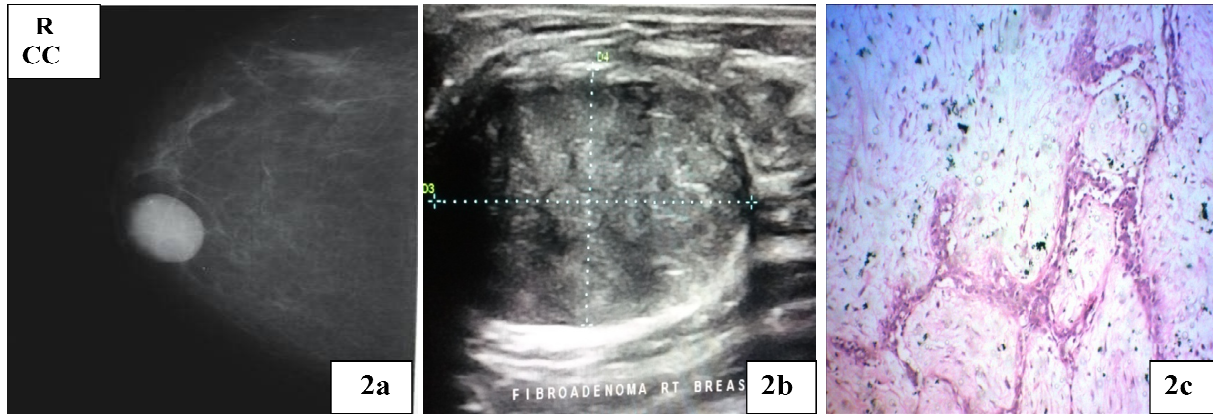
breasts, mammography has limited sensitivity and ultrasound is the preferred modality.

Dujim et al concluded that they found the sensitivity for breast cancer detection was 92.0% and the specificity was 97.7%. A positive predictive value of 68.0% a negative predictive value of 99.6%, a positive likelihood ratio of 40 and negative likelihood ratio of 0.08. [10]

In our study, 58.1% had ultrasonographic features of benign lesion and 32.7% had features of malignancy. 5(9.0%) cases were diagnosed as normal by ultrasound. Pathology revealed 60% of the lesion to be benign and 30.9% to be malignant. The specificity, sensitivity, and accuracy of ultrasonography were 96%, 96%, and 96.3%

respectively. The positive and negative predictive values were 100 and 60. 14 patients had cystic lesions and were benign. Ultrasound was a better modality compared to mammogram in differentiating the cystic lesions from solid lesions. Histological

tumor types included 8 invasive ductal carcinomas, 6 ductal carcinomas in situ, and 3 stromal tumors. By ultrasound, one benign case was diagnosed as malignancy.



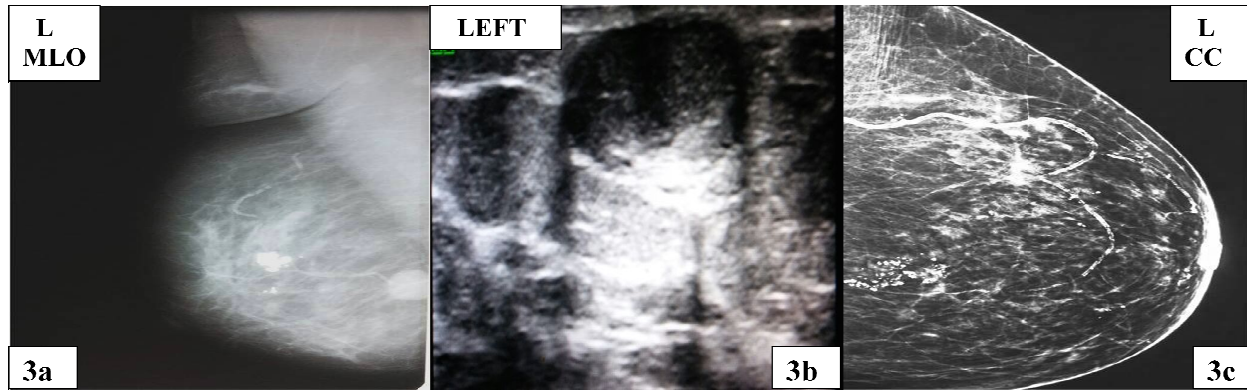
**Figure2(a-c):** Mammogram shows (a) a well-defined, oval hyperdense lesion with a peripheral halo in subareolar region. Usg of another patient shows (b,c) a well-defined, oval, encapsulated, iso-hyper echogenic lesion with a parallel orientation to the skin and acoustic enhancement with HPE of the same patient showing an intra canalicular fibroadenoma.

In a study Shahid R , Ghaffar A , Bhatti AM included 85 female patients with positive clinical findings and differentiated into benign (n =45, 52.9%), intermediate (n =15, 17.6%) and malignant (n =25, 29.4%), by ultrasound examination. The specificity was 68.75% for a benign lesion and sensitivity of ultrasound for malignant lesion was 95.24%. Only one (2.2%) benign lesion was found malignant on histopathology, 8 (32%) cases of malignant group were benign on histopathology.<sup>[11]</sup>

#### COMBINED APPROACH OF BOTH MODALITIES:

Shetty MK and Shah YP reported a sensitivity of 100% and specificity of 80.1% in a combined approach.<sup>[12]</sup>

In our study, by combining both the modalities the specificity, sensitivity, and accuracy were 100%, 97.8%, and 98.1% respectively. The positive and negative predictive values were 100 and 81.59. Hence according to our study, a combined approach increased the accuracy in detecting the lesions compared to a single modality approach.



**Figure3(a-c):** Mammogram shows (a) well-defined, hyperdense oval lesion in lower quadrant with popcorn calcification in central quadrant and accessory breast. Usg of the same patient shows (b) a well-defined, oval, hypoechoic lesion parallel in orientation with macrocalcification and acoustic enhancement-benign calcification. Mammogram shows (c) cluster and vascular calcification, scattered microcalcification calcification-malignant calcification.

S. Prasad in his study showed an efficiency of 81.8% for mammography compared to 95.5% for ultrasonography and a combined approach resulted in 100% in detecting fibrocystic mastitis. In case of fibroadenomas, mammography showed 75% efficiency and ultrasonography only 35% and the combination resulting in 93.7%. For carcinomas, mammography had an efficiency of 77.8% and ultrasonography 55.6%, but the combination had an efficiency of 98.1%. Overall, the histopathological reports when correlated with each modality showed that mammography had an efficiency of only 77.4% and ultrasonography 69.8% compared to an efficiency of 98.1% obtained in a combined approach.<sup>[13]</sup>

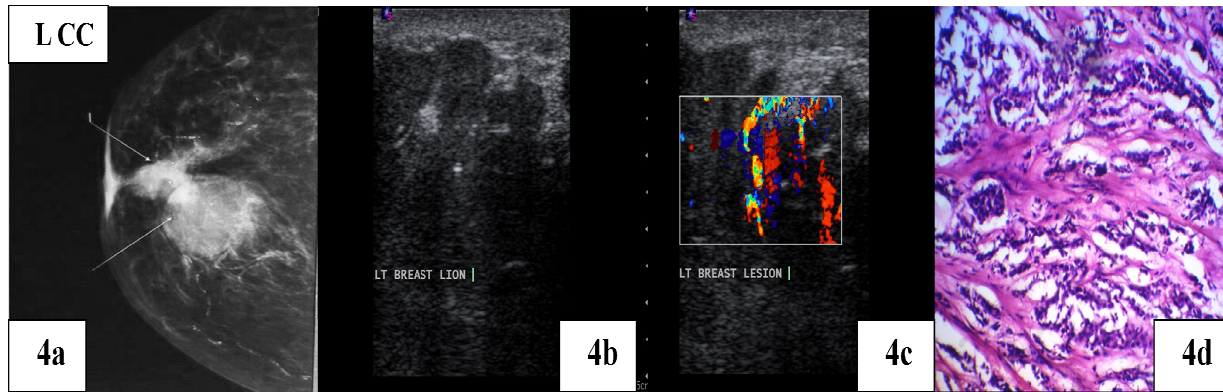
#### **BIRADS ASSESSMENT:**

In this prospective study, the lesions were analyzed for various features according to the BI-RADS mammogram and BI-RADS ultrasound descriptors. BI-RADS MAMMOGRAM descriptors like shape, margin, calcification, associated features showed

statistically significant p-values ( $p < 0.002$ ,  $p = 0.005$ ,  $p = 0.0034$ , and  $p = 0.0207$ , respectively) and density, asymmetry were not statistically significant ( $p = 0.626$ ,  $p = 0.127$ ) with a 95% confidence interval. 32 masses had regular margins and all were benign, 13 had irregular margins (1 benign and 12 malignant). 30 had circumscribed margins and were benign, 15 had not-circumscribed margins (3 benign and 12 malignant). 45 lesions were hyperdense (12 malignant and 33 benign). Asymmetry was present in 2 malignancies. Calcification was seen in 16 cases (9 benign and 7 malignant) and absent in 39 cases. Associated features like lymph node, skin changes, architectural distortion were seen in 9 cases (3 benign and 6 malignant).

The sensitivity and specificity for each of the features were shape (96.97% and 98%), margin (90.91% and 73.54%), density (89.42% and 26.46%), asymmetry (10.28% and 88.24%), calcification (23.68% and 58.82%), associated features (8.11% and 64.71%) respectively.





**Figure4(a-d):**Mammogram shows (a) an ill-defined hyperdense lesion with spiculated margins and nipple retraction. Usg of the same patient showing (b,c) an ill-defined, irregular, hypoechoic lesion with nonparallel orientation and increased vascularity (d) HPE shows ductal carcinoma with stromal invasion (X 10).

In this study, according to BI-RADS US descriptors shape, margin, echo pattern, orientation, posterior acoustic shadowing had statistically significant p-values ( $p = 0.0001$ ,  $p = 0.0001$ ,  $p < 0.0001$ ,  $p \leq 0.0142$ ,  $p = 0.0002$  respectively) with 95% confidence interval. Calcification was not statistically significant ( $p=0.692$ ). 33 masses had regular margins and all were benign, 19 had irregular margins (2 benign and 17 malignant). 36 had circumscribed margins (34 benign and 2 malignant), 16 had not-circumscribed margins (1 benign and 15 malignant). 50 lesions were hyperechoic (16 malignant and 34 benign), 2 were hyperechoic (1 benign and 1 malignant). Posterior acoustic shadowing was present in 14 patients (3 benign and 11 malignant) and absent in 38 patients. 46 patients had a parallel orientation of the lesion (35 benign and 11 malignant) and 6 malignant lesions were non-parallel in orientation. Calcification was seen in 8 cases (5 benign and 3 malignant) and absent in 46 cases. Associated features like lymph node, skin changes, architectural distortion, vascularity were seen in 8 cases (3 benign and 5 malignant) and absent in 46 cases.

The sensitivity and specificity for shape (94% and 80%), margins (97% and 88%), echo pattern (97% and 94%) and orientation (90% and 35%) were better indicators in differentiating benign and malignant lesions compared to other features like posterior acoustic shadowing (8.57% and 35.29%) calcification (13.51% and 82.35%).

Man Chen, Wei Wei Zhan, Wen Ping Wang concluded that the BI-RADS US descriptors of cystic breast lesions were statistically significant variables for malignancy including shape, margin, echo pattern, orientation, calcification, and vascularity. Furthermore, parallel orientation, regular shape, non-complex echo pattern, circumscribed margin, absence of posterior acoustic feature, calcification, and vascularity of lesions showed high predictive value for benign lesions. Not parallel to skin and presence of vascularity implied high predictive value for malignant cystic lesions.<sup>[14]</sup>

#### CONCLUSION:

Breast cancer is a commonly prevalent cancer in the world among women. Imaging modalities like mammography and ultrasonography though they have an acceptable accuracy rate, the sensitivity, and

specificity for detecting the breast lesions increase when both modalities are applied together with histopathology as the gold standard to confirm the imaging findings.

In this study we confirm that ultrasonography when combined with mammography in detection of breast lesions has more specificity, sensitivity, and accuracy when compared to a single modality in detecting breast lesions. Also categorization of lesions

according to BI-RADS mammogram and Ultrasound descriptors is useful for characterization and differentiation of benign from malignant breast lesions.

Hence all cases that report for regular screening and for breast symptoms must undergo mammography and ultrasonography as a routine for increasing the diagnostic accuracy in detecting the lesion.

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