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## Sonographic Characterization of breast masses with pathological correlation

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### Abstract

Breast cancer is the most common cancer in women worldwide. It is the fifth most common cause of death from cancer in women. Early detection is required to decrease breast cancer related deaths. The effective diagnosis and management of breast lesions involves multidisciplinary approach to their assessment. The precision of the final diagnosis can be greatly increased by radiological imaging and pathological diagnosis, Ultrasonography is an excellent modality, especially in patients with dense breasts and it also helps to characterize a lesion undetected on mammography. Combining both these modalities (mammography and ultrasonography) yield best results. Sonologically diagnosed lesions, were confirmed by FNAC/HPE.

The aim of the study is to study the sonographic characteristics of breast lesions in patients with breast lump. All patients clinically diagnosed with a palpable breast lump referred to the department of radiology, were included in the study. Whole-breast sonography, using a high frequency (12-4 mhz) linear probe of both breasts was done in a radial and anti-radial orientation.

Data was collected from a sample size of 80 patients. The median age in the study was 38 years. Histopathology/FNAC was the gold standard in our study. All 80 cases were subjected to histopathological/FNAC examination for final diagnosis. Fibroadenoma was the commonest benign lesion (63.8%). Breast carcinoma was seen in 36.2% of patients. Most of the tumors found in our study were invasive ductal carcinomas (51.7%).

**Keywords:** Fine needle aspiration cytology (FNAC), Histo-pathological examination (HPE), ultrasonography (USG), BI-RADS (Breast imaging reporting and data system)

### Introduction

Breast cancer is the most common cancer in women worldwide. It is the fifth most common cause of death from cancer in women <sup>[1]</sup>. Breast cancer projection for India during time periods 2020 suggests the number to go as high as 17, 97, 900 <sup>[2]</sup>. Breast cancer risk doubles each decade until the menopause, after which the increase slows. However, breast cancer is more common after the menopause <sup>[3]</sup>. Early detection and improved treatment is required to decrease breast cancer related deaths. The effective diagnosis and management of breast lesions involves multidisciplinary approach to their assessment. The precision of the final diagnosis can be greatly increased by radiological imaging and pathological diagnosis <sup>[4]</sup>. Non-invasive techniques such as mammography, is a well-defined and widely accepted radiologic procedure to evaluate clinically suspected breast lesions and as a tool to screen for breast cancer. However, the appearance of overlapping tissue on mammograms poses a significant obstacle to interpretation. Hence, ultrasonography is an adjunctive modality, especially in patients with dense breasts and it also helps to characterize a undetected abnormality on mammography. Combining both the modalities (mammography and ultrasonography) yielded the best results. Ultrasonography and mammography diagnosed lesions, were confirmed by FNAC. As FNAC is an invasive procedure, imaging modalities that can detect and grade the lesions will reduce the requirement of subjecting the patient to invasive procedures especially in definitive benign lesions<sup>1</sup>. The present study is to evaluate the breast lesions by using sonography procedure (non-invasive method) in comparison with FNAC and histopathology (invasive method).

### Aims

To study the sonographic characteristics of breast lesions in patients with breast lump

**Objectives**

1. To study the sonographic characteristics of breast lesions.
2. To compare the categorized breast lesions with FNAC and tissue diagnosis.

**Material and Methods**

A prospective cross sectional study was carried out in the Department of Radio diagnosis of Kamineni Institute of medical sciences, Narketpalli hospital after obtaining clearance from the ethical committee. Study population included patients with clinically diagnosed breast lump referred to Department of Radio diagnosis for sonography of breasts. Data was collected from October 2017 to September 2019 with a sample size of 80 patients.

**Inclusion Criteria**

- Patients clinically diagnosed with a palpable breast lump referred to the department of radiology, Kamineni Institute of medical science.

**Exclusion Criteria**

- Patients who are already diagnosed and treated for breast lump, post-traumatic breasts, cysts and abscesses.

**Ultrasonography**

Whole-breast sonography, using a high frequency (12-4 mhz) linear probe of both Breasts. Sonographic abnormalities were also scanned in radial and anti-radial orientation. The Ultrasonography findings were recorded on the Proforma as shown below- • Location• Size• Shape• Margin • Longitudinal axis versus anterior posterior diameter• Posterior Echo Intensity• Echogenicity • Internal Structure Complex, Homogeneous and Heterogeneous • Calcification –Micro/macro calcifications • Surrounding Breast Parenchyma • Overlying Skin • Underlying Muscle and Chest wall • Bilateral Lymph Nodes • Color Doppler-

App of Blood Vessels and their Pattern of distribution • Spectral Waveforms - Resistive index.. All the index lesions studied based on sonographic features were categorized according to BIRADS (ACR; Reston, VA). Categories 2 & 3 were taken as benign while 4 & 5 as malignant. These patients were then subjected to pathological correlation using FNAC and HPE.

**Statistical Tools**

Data entry was done using M.S. Excel and statistically analysed using Statistical package for social sciences (SPSS Version 21) for M.S Windows. Descriptive statistical analysis was carried out to explore the distribution of several categorical and quantitative variables. Categorical variables were summarized with n (%), while quantitative variables were summarized by mean ± S.D. All results were presented in tabular form and are also shown graphically using bar diagram or pie diagram as appropriate. Categorical variables was tested by chi square test. P-value less than 0.05 considered as statistically significant

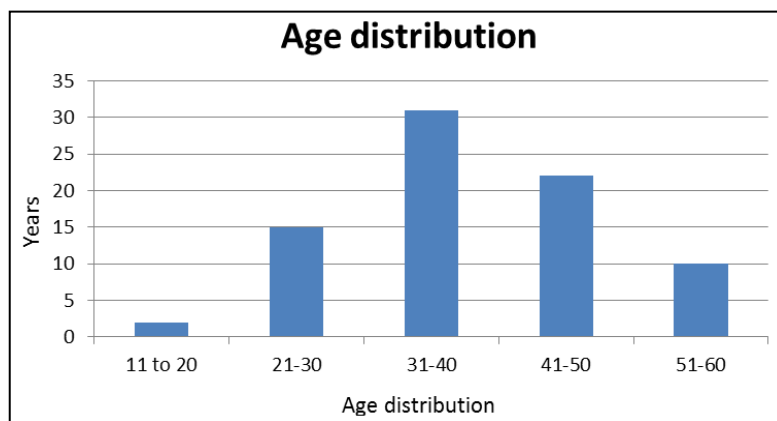
**Observations and Results**

**Table 1:** Distribution of patients according to age group (n=80)

Age Groups (in years)	Number of Patients
11-20	2
21-30	15
31-40	31
41-50	22
51-60	10
Total	80

There were 31 patients in third decade of life followed by 22 in fourth decade of life.

10 patients were above 50 years and 17 patients were below 30 years. The median age was 38 years (range=19-60 years).



**Graph 1:** Distribution of patients according to age group

**Table 2:** Presenting Symptoms of the patients (n=80)

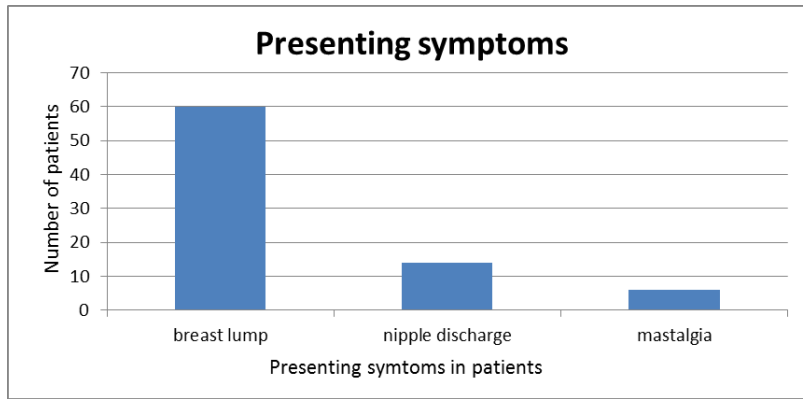
Symptoms	Number of patients
Palpable lump	60
Nipple Discharge	14
Mastalgia	6
Total	80

A palpable breast lump was the most common presenting complaint (n=60). Fourteen patients presented with

serosanguinous nipple discharge. Six patients came with complaints of mastalgia.

**Table 3:** Ultrasonography Findings in the patients (n=80)

Ultrasonography Findings	Number of Lesions
Mass Only	16
Mass with micro calcification	18
Dilated ducts	12
Axillary nodes	22



**Graph 2:** Presenting Symptoms of the patients (n=80)

Some patients had more than one finding on mass with micro calcifications. Axillary lymph nodes were ultrasonography. Focal mass was the most common seen in 22 patients. ultrasonography finding in this study. 18 patients showed

**Table 4:** Shape of the index mass lesion on Ultrasonography (n=80)

Shape of lesion			Diagnosis		Total
			Benign Masses	Malignant Masses	
Shape	Irregular	N	4	20	24
		%	7.8%	68.9%	30%
	Oval	N	42	3	45
		%	82.4%	10.4%	56.3%
	Round	N	5	6	11
		%	9.8%	20.7%	13.7%
Total		N	51	28	80
		%	100.0%	100.0%	100.0%

**Table 5:** Margins of the index lesion on Ultrasonography (n=80)

Margins on USG			Diagnosis		Total	
			Benign Masses	Malignant Masses		
Margins	Angular	N	3	1	4	
		%	5.9%	3.4%	5%	
	Micro lobulated	N	2	3	5	
		%	3.9%	10.3%	6.3%	
	Spiculated	N	0	17	17	
		%	0%	58.6%	21.3%	
	Smooth	N	40	2	42	
		%	78.4%	6.9%	52.5%	
	Indistinct	N	6	6	12	
		%	11.8%	20.7%	15%	
	Total		N	51	29	80
			%	100.0%	100.0%	100.0%

**Table 7:** Posterior echo intensity in index lesion (n=80)

Posterior acoustic intensity			Diagnosis		Total
			Benign Masses	Malignant Masses	
Posterior echo intensity	Attenuated	N	5	19	24
		%	9.8%	65.5%	30%
	Enhanced	N	18	2	20
		%	35.3%	6.9%	25%
	Combined	N	28	8	36
		%	54.9%	27.6%	45%
Total		N	51	29	80
		%	100.0%	100.0%	100.0%

**Table 8:** Echogenicity of the index lesion (n=80)

Echogenicity			Diagnosis		Total
			Benign Masses	Malignant Masses	
Echogenicity	Hypoechoic	N	45	23	68
		%	90.2%	79.3%	86.3%

	Isoechoic	N	02	0	02
		%	3.9%	0%	2.5%
	Anechoic	N	1	0	1
		%	1.9%	0%	1.3%
	Mixed	N	03	06	09
		%	3.9%	20.7%	10%
Total		N	51	29	80
		%	100.0%	100.0%	100.0%

**Table 9:** Micro calcification within the index lesion (n=80)

Microcalcifications			Diagnosis		Total
			Benign Masses	Malignant Masses	
Microcalcifications	Present	N	2	16	18
		%	3.9%	55.2%	22.5%
	Absent	N	49	13	62
		%	96.1%	44.8%	77.5%
Total		N	51	28	80
		%	100.0%	100.0%	100.0%

**Table 10:** Flow characterization of index lesion on Colour doppler sonography (n=80)

Vascularity			Diagnosis		Total
			Benign Masses	Malignant Masses	
Vascularity	Present	N	29	26	25
		%	56.9%	89.6%	68.7%
	Absent	N	22	3	25
		%	43.1%	10.4%	31.3%
Total		N	51	28	80
		%	100.0%	100.0%	100.0%

**Table 11:** Resistive index lesion on colour duplex sonography (n=80)

Resistive index			Diagnosis		Total
			Benign Masses	Malignant Masses	
Resistive index	<0.99	N	26	2	28
		%	86.7%	8%	50.9%
	>1.00	N	4	23	27
		%	13.3%	92%	49.1%
Total		N	51	28	80
		%	100.0%	100.0%	100.0%

**Table 12:** BI-RADS category of index lesions on us (n=80)

BIRADS Category			Diagnosis		Total
			Benign Masses	Malignant Masses	
BIRADS	2	N	6	0	6
		%	11.8%	0%	7.5%
	3	N	38	10	48
		%	74.5%	34.5%	60%
	4	N	7	17	24
		%	13.7%	58.6%	30%
	5	N	0	2	2
		%	0%	2.5%	2.5%
Total		N	51	29	80
		%	100.0%	100.0%	100.0%

**Table 13:** Results of comparison of BI-RADS with FNAC

Statistics for FNAC	Value
Sensitivity	85.2%
Specificity	58.3%
Disease Prevalence	85%
Negative Likelihood ratio	0.25
Positive predictive value	92%
Negative Predictive value	41.1%

**Table 14:** Results of comparison of BI-RADS with biopsy

Statistics for FNAC	Value
Sensitivity	91.5%
Specificity	57.1%
Disease Prevalence	73.7%
Negative Likelihood ratio	0.15
Positive predictive value	85.7%
Negative Predictive value	70.5%

**Table 15:** Comparison of USG classification with pathologic findings

USG	Pathologic Findings		Total
	Benign	Malignant	
Benign	50 (True negative)	1 (False negative)	51
Malignant	9 (False positive)	20 (True positive)	29

**Results**

The median age in the study was 38 years (range = 19-60 years). A palpable breast lump alone was the most common presenting complaint (n = 60). Axillary lymph nodes were seen in 22 patients.

The most common shape of the index lesion was oval (n = 45) followed by irregular (n=24), lobulated (n = 14), round (n = 8). Most common shape in benign lesions was oval (n = 42) whereas in malignant lesions it was irregular shape (n = 20). Margins of the index mass lesions were spiculated (n = 17) and smooth in (n = 42), angular was least common (n = 4). Spiculated margins were only seen in malignant lesions while most of the benign lesions were found to have smooth margins. Post-acoustic enhancement was present in 35.3% of benign masses and 6.9% of malignant lesion. Most common echogenicity was hypoechoic both in malignant and benign lesions.

55.2% of malignant lesions and 3.9% of benign lesions showed micro-calcifications.

All the 80 index lesions were evaluated by colour Doppler sonography for detection of colour signals. Most common pattern of vascularization was penetrating seen in 76.7% of malignant and 13.1% of benign lesions. Most of the malignant lesions were having RI value greater than 0.99 (92%) RI value was less than 0.99 in 86.7% of benign lesion. Most common BI-RADS category noted in this study was type 3 (n=48). The sensitivity of ultrasound in lesions that went in for FNAC was 85.2% and specificity 58.3%. The negative likelihood ratio was 0.25. The sensitivity of ultrasound lesions that went in for biopsy after FNAC had a sensitivity of 91.5% and a specificity of 57.1%. The negative likelihood ratio was 0.15. Thus, breast lesions evaluated by ultrasonography for malignancy had a Sensitivity of 95.2%, specificity of 84.7%, positive predictive value 98.04% and negative predictive value 68.9%.

Histopathology/FNAC was the gold standard in our study. All the 80 cases were subjected to histopathological/FNAC examination for final diagnosis. Fibro adenoma was the commonest benign lesion (63.8%). Breast carcinoma was seen in 36.2% of patients. All of the papillary breast lesions were diagnosed as intra-ductal papilloma. Most of the tumors found in our study were invasive ductal carcinomas (51.7%) except two that was medullary carcinoma (6.9%). Two mucin secreting adenocarcinoma (6.9%) was found.

**Discussion**

Breast cancer most commonly manifests as a palpable breast lump. Nipple discharge, especially sanguineous or serosanguinous is another common symptom.

Mumtaz *et al.* [5] & Liberman *et al.* [6], Berg *et al.* [7] studies showed breast lump as the most common presenting symptom.

Axillary lymphadenopathy was seen in 8% cases in Khaleel IM *et al.* [8]

In Zende UM *et al.* [16] mean presentation age group was 35.13 yrs similar to our study and Fibroadenoma was the

commonest lesion detected while in Dina MA *et al.* [9] the most common disease was fibrocystic disease.

The characteristic sonographic findings of breast malignancy include irregular shape, hypoechogenicity, posterior acoustic shadowing, taller than wide, presence of calcification, microlobulation, duct extension, spiculated and angular margin. [10, 11-15]

The typical features of benign tumors include oval and ellipsoid shape, hyperechoic lesion with gentle bi- or trilobulations, a thin echogenic pseudo capsule [10, 11-13, 17, 18] Stavros *et al.* [19] Skaane *et al.* [15] Rahbar *et al.* [10] all reported ellipsoid shape to have high sensitivity and specificity for benign lesions.

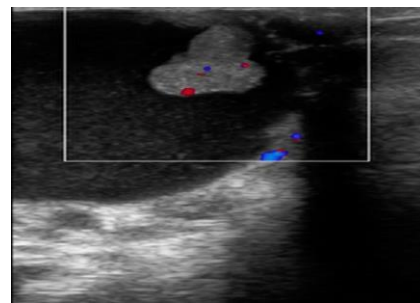
The presence of punctuate echogenic calcification within solid nodule is indicative of malignancy [12, 14] Berg WA *et al.* [20] reported micro calcification in 9.6% of benign masses and 48% of malignant masses, similar to our study.

Any lesion with a vessel having a RI (Resistive Index) value greater than 0.99 or a PI (Plasticity Index) value greater than 4 should be considered as probably malignant regardless of any other sign present in sonography [21]. Del Cura *et al.* [21] reported that 97% of tumors in which this sign appears were carcinomas.

Damle RP *et al.* [22], Bakde A *et al.* [23], Kalwani R *et al.* [24] all showed high sensitivity and specificity of USG findings in correlation with FNAC/HPE

In our study, most common BI-RADS category noted was type 3 (n = 48) Most of the malignant lesions were in category 4 (n = 17). Similarly in Mallik R *et al.* [26] maximum cases where in BIRADS 3 category

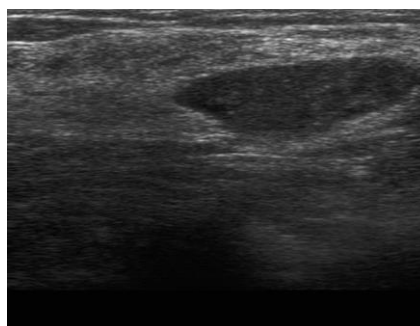
**Case 1**



**Intra ductal carcinoma**

This is a case of a 49 year old female with complaints of pain in the right breast since 4months. There was a well defined cystic lesion with internal echoes. A lobulated solid mass noted within showing central vascularity. Lesion is showing posterior acoustic enhancement.

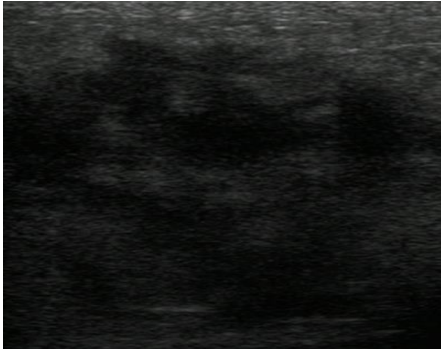
**Case 2**



### Fibroadenoma

This is a case of a 26 year old female with with complaints of a painless lump in the right breast. There was a well defined, oval shaped hypoechoic parallelly oriented solid mass lesion, showing slight posterior acoustic enhancement.

### Case 3



### Intra ductal carcinoma in situ

This is a case of a 50 year old female with complaints of a painless lump in the right breast since 1yr. There was an ill defined mass lesion with spiculated margins showing both solid and cystic component and with a few hyperechoic foci.

### Conclusion

Ultrasound is a very sensitive imaging modality for the screening and evaluation of suspicious breast lesions and the disease extent with tumor margin being most important sonographic feature in evaluating breast lesions in my study. And with the combination of significant factors and emphasis on specific features, the diagnostic accuracy of ultrasound for differentiating malignant and benign tumors may be improved. The results of the present study showed the most important sonographic features for differentiating benign from malignant solid masses. This can help to reduce the unnecessary biopsies performed for benign solid masses.

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