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Original Article

Radiology Section

A Comparative Study of Mammography and Sonomammography with Histopathology in Evaluating Palpable Breast Masses

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ABSTRACT

Introduction: Breast lump is the clinical presentation of various breast diseases that range from benign cyst to malignant lesions. Differentiation of benign from malignant is the most important aspect for patient care and proper management.

Aim: To evaluate the mammographic and sonomammographic features of the clinically palpable breast masses. To characterize the breast masses into benign and malignant based on mammographic, sonographic findings and to compare imaging findings with histopathology.

Materials and Methods: This prospective study was conducted in the Department of Radiodiagnosis, Mysore Medical College, for duration of one year. Sixty women, above 30 years of age with palpable breast mass were evaluated by mammography and sonomammmography, followed by histopathology. Diagnostic accuracy was calculated in terms of sensitivity, specificity, positive predictive value, negative predictive value for mammography, sonography individually and in combination.

Results: Present study revealed 37 benign and 23 malignant cases on histopathological analysis. Of 60 palpable masses, mammography detected 52 cases and eight were occult. Ninety percent of the mammographically malignant cases were proved to be malignant on histopathology and 96.8% of mammographically benign cases were benign on histopathology, resulting in sensitivity, specificity, PPV and NPV of 94.7%, 93.9%, 90% and 91.2% respectively. Sonomammography was normal in two of the patients and 39 of the 58 sonomammographically detected lesions were solid and rest were cystic or predominantly cystic lesions. Ninety one percent of the sonomammographically malignant cases were proved to be malignant on histopathology and 97.1% of sonomammographically benign cases were benign on histopathology, resulting in sensitivity, specificity, PPV and NPV of 95.4%, 94.4%, 91.3% and 97.1%, respectively. Combining mammography with sonomammmography yielded better characterization of mass lesions with sensitivity and NPV of 100.0% and increased specificity and PPV of 94.6% and 92% respectively.

Conclusion: Imaging has an important role in the management of palpable breast masses. Combined use of mammography and sonomammography provides very high diagnostic accuracy, helps in better characterisation of palpable lesions, reduces patient anxiety and avoids unnecessary interventions in cases where imaging findings are unequivocally benign.

Keywords: Benign, Breast lump, Malignant, Sensitivity, Specificity

INTRODUCTION

Breast lump is the clinical presentation of various breast diseases that range from benign cyst to malignant lesions. Differentiation of benign from malignant is the most important aspect for patient care and management. Mammography is a widely accepted technique to screen for breast cancer and to evaluate clinically suspected breast lesions. It is very useful in predicting the presence of malignancy if mammographic lesions are placed into BIRADS categories [1]. The role of ultrasonography in breast imaging has evolved over the years and today it plays an important role in diagnosing and guiding interventional procedures such as needle aspiration, core-needle biopsy and pre-biopsy needle localization. It is useful in the evaluation of palpable masses not visible in mammographically dense breast, abscesses, in evaluation of pregnant and lactating mothers and in young patients susceptible to radiation. Also, the use of sonography as an adjunctive modality to mammography results in increase in diagnostic accuracy.

Combined mammography and sonography have demonstrated higher sensitivity, specificity and a near 100% negative predictive value for palpable breast masses. Together these imaging modalities can be reassuring if follow-up is planned when the physical examination is not highly suspicious and unnecessary breast biopsy can be avoided [2]. Hence, this study was carried out to provide a systematic and practical approach in evaluation of breast masses with an aim to evaluate mammographic and sonographic features of the clinically palpable breast masses, characterise the breast masses into benign and malignant based on imaging findings and to correlate with histopathology.

MATERIALS AND METHODS

This prospective study was performed for a duration of one year in the Department of Radiodiagnosis, Mysore Medical College. Sixty women, above 30 years of age with complaint of palpable breast mass were included in the study after informed consent. Approval from institutional ethics committee was obtained. Women with fungating mass in breast and mass adherent to chest walls where performing mammography is difficult and pregnant/lactating women were excluded from the study.

Mammography was performed as an initial imaging examination, followed by sonography. Mammography was performed using Siemens Mammomat 3000 Nova equipment in two views (i.e., cranio-caudal and medio-lateral oblique views). The mammographically detected lesions were assessed using the ACR-BIRADS Lexicon. Sonographic examination of the breast was performed in real time, in gray scale and colour doppler modes using a high-resolution linear array transducer of ESOATE MYLAB 40 equipment. These lesions were then classified into benign and malignant and comparison of the categorized lesions with histopathology was done.

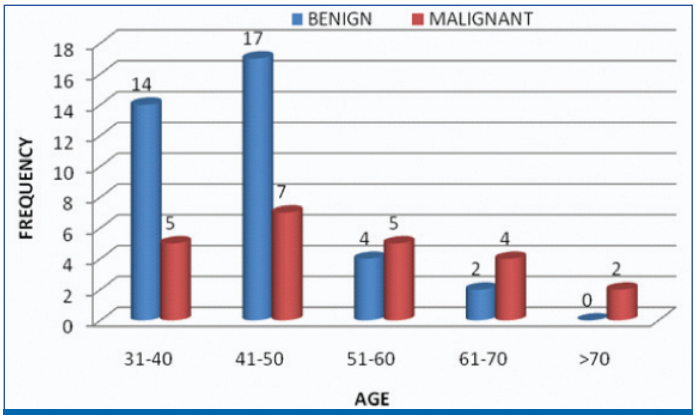
STATISTICAL ANALYSIS

Diagnostic accuracy was calculated in terms of sensitivity, specificity, positive predictive value, negative predictive value for

mammography, sonography individually and in combination. Both descriptive and inferential statistics were employed for data analysis. The descriptive statistical procedure displays uni-variate summary statistics for several variables in a single table and calculates standardized values. Variables can be ordered by the size of their means, alphabetically, in ascending or descending order or by the order in which the researcher selects the variables. All the above analysis was performed with the use of SPSS v 20 software.

RESULTS

The median patient age in the benign and malignant groups was 43 years [Table/Fig-1].



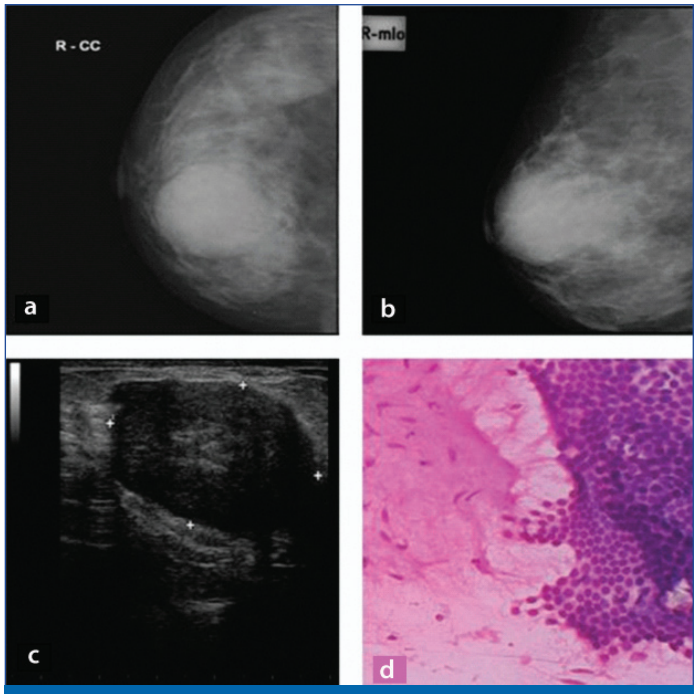
[Table/Fig-1]: Age distribution of palpable breast masses.

Of the 60 palpable masses, mammography detected 52 cases and eight were occult, while ultrasound was normal in two of the patients. Thirty nine of the 58 sonographically detected lesions were solid and rest were cystic or predominantly cystic. The 52 mammographically detected masses and 39 sonographic solid masses were then analysed for individual features favouring benignity or malignancy and the results were tabulated. In the study of 60 patients, [Table/Fig-2], 37 cases were benign (59.9%) and 23 were malignant (38.3%) on histopathology, with fibroadenoma (n=16) [Table/Fig-3] being the most common benign lesion, followed by benign cyst (n=14) and invasive ductal carcinoma (n=18), being the most common malignant lesion [Table/Fig-4,5].

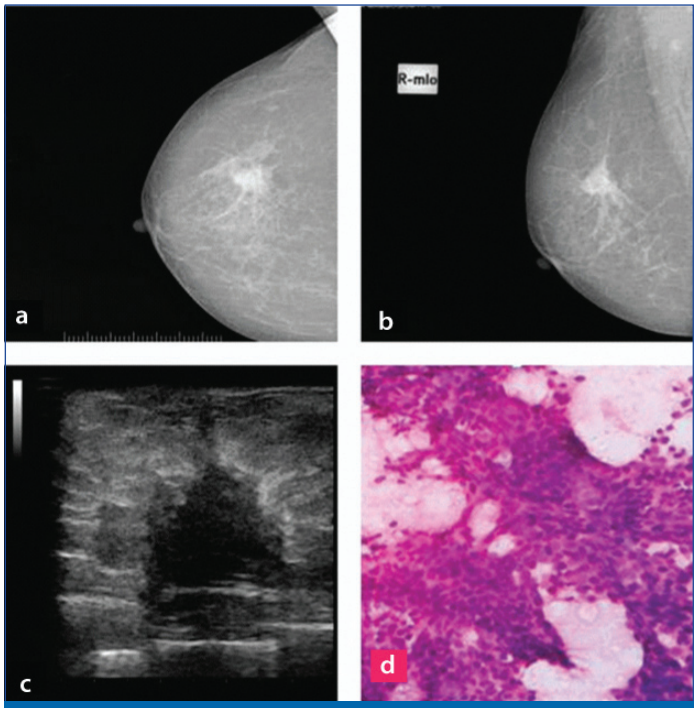
FNA/HPR diagnosis		Number	Percentage %
Benign	Fibroadenoma	16	26.6%
	Benign cyst	14	23.3%
	Fibrocystic disease	2	2.6%
	Phyllodes tumour	2	2.6%
	Papilloma	1	1.6%
	Lipoma	1	1.6%
	Adenomyoepithelioma	1	1.6%
Malignant	Ductal carcinoma in-situ	3	5%
	Invasive ductal carcinoma	18	30%
	Papillary carcinoma	1	1.6%
	Mucinous carcinoma	1	1.6%
Total		60	100.0%

[Table/Fig-2]: FNA/HPR results of palpable breast masses.

The mammographic features of irregular shape, spiculated/ill-defined margins, micro-calcification, axillary lymphadenopathy, skin thickening/retraction and nipple retraction were more frequently seen in malignant nodules than benign and were individually statistically significant for depiction of a malignant lesion. The mammographic features of oval/round shape, circumscribed margins, radiolucent halo and macro-calcification were more frequently seen in benign than malignant lesions and were individually statistically significant for depiction of a benign lesion. Density of the mass did not show statistical significance [Table/Fig-6].



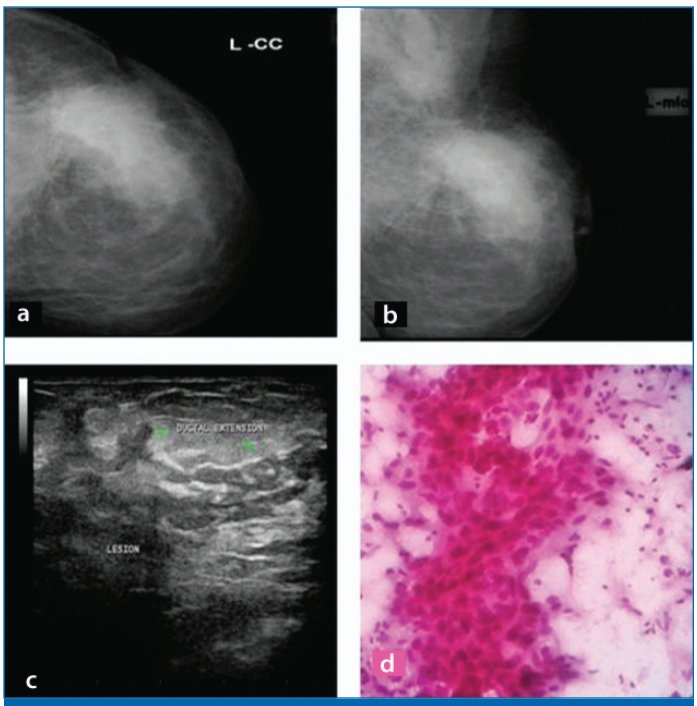
[Table/Fig-3]: Fibroadenoma: a,b) CC and MLO views of mammography showing an oval shaped, circumscribed mass in the retro-areolar region with perilesional halo; c) High resolution sonomammographic image showing an oval shaped, well circumscribed homogenously hypoechoic solid mass, in parallel orientation, with posterior acoustic enhancement; d) FNA smear shows benign ductal epithelial cells and fibromyxoid stroma. H&E (400x).



[Table/Fig-4]: Ductal Carcinoma In-Situ: a,b) CC and MLO views of mammography showing an irregular, spiculated mass in upper outer quadrant; c) High resolution sonomammographic image showing an irregular, spiculated, hypoechoic solid mass with posterior acoustic shadowing; d) FNA smear shows sheets of ductal epithelial cells in cribriform pattern; necrotic debris. H&E (400x).

Mammography was inconclusive in 8 of the 60 cases. Of the 8 occult cases, 4 were benign and 4 malignant on histopathology. Ninety percent (n=18) of the mammographically malignant cases were proved to be malignant on histopathology and 96.8% (n=31) of mammographically benign cases were benign on histopathology [Table/Fig-7].

Sonography detected 58 masses and was normal in two of the patients. A total of 39 of the 58 sonographically detected lesions were solid and rest were cystic or predominantly cystic lesions. Benign and malignant lesions were almost equally distributed in solid lesions while 89.5% of cystic lesions were benign.



[Table/Fig-5]: Invasive Ductal Carcinoma: a,b) CC and MLO views of mammography showing an irregular, spiculated mass in the upper outer quadrant with intralesional microcalcification and axillary lymphadenopathy; c) High resolution sonomammographic image showing an irregular, spiculated, hypoechoic solid mass with posterior acoustic shadowing and ductal extension of mass; d) FNA smear show pleomorphic ductal epithelial cells and mitoses. H&E(400x).

Characteristics	Benign (33)	Malignant (19)	Total (52)	p-value
Shape				<0.001
Oval	15	1	16	
Round	13	2	15	
Irregular	5	16	21	
Margin				<0.001
Circumscribed	32	4	36	
Spiculated	0	9	9	
Ill Defined	1	6	7	
Density				0.738
High	30	18	48	
Iso	2	1	3	
Low	1	0	1	
Associated features				<0.002
Halo Sign	3	0	3	
AN/SR/ST/NP*	0	6	6	
Absent	30	13	43	
Calcification				<0.001
Micro	0	10	10	
Macro	2	1	3	
Absent	35	12	47	

[Table/Fig-6]: Significance of mammographic characteristics in differentiation of benign and malignant breast masses.
*Axillary nodes/Skin retraction/Skin thickening/Nipple retraction

Mammographic lesion	FNA/HPR diagnosis		Total	p-value
	Malignant	Benign		
Malignant	18 (90.0%)	2 (10.0%)	20 (100.0%)	<0.001(s)
Benign	1 (3.1%)	31 (96.8%)	32 (100.0%)	
Total	19 (36.5%)	33 (63.5%)	52 (100.0%)	

[Table/Fig-7]: Comparison of mammographic characterisation with histopathology.

The sonographic features of irregular shape, spiculated/ill-defined margins, antiparallel (Taller than wider) orientation, posterior acoustic shadowing, vascularity with a RI >0.7 and axillary lymphadenopathy were more frequently seen in malignant lesions than benign and were individually statistically significant for depiction of a malignant lesion. The features of oval shape, circumscribed margins, parallel orientation, posterior acoustic enhancement were more frequently seen in benign than malignant lesions and were individually statistically significant for depiction of a benign lesion. Echo-pattern of the mass and presence of calcification did not show statistical significance [Table/Fig-8,9].

Characteristics	Benign (19)	Malignant (20)	Total (39)	p-value
Shape				<0.001
Oval	13	1	14	
Round	1	1	2	
Irregular	5	18	23	
Margin				<0.001
Circumscribed	18	6	24	
Spiculated	1	8	9	
Ill Defined	0	6	6	
Orientation*				<0.001
Parallel	15	3	18	
Anti-parallel	2	15	17	
Echo pattern				0.408
Heterogenous	7	10	17	
Hypo-echoic	12	10	22	
Post acoustic features#				<0.001
Post acoustic shadowing	3	14	17	
Post acoustic enhancement	14	2	16	
Presence of calcification	2	7	9	0.144
Vascularity	4	16	20	<0.001
RI { >0.7}	0	11	11	<0.001
Axillary lymph adenopathy	1	11	12	<0.001

[Table/Fig-8]: Significance of sonomammographic characteristics in differentiation of benign and malignant solid breast masses.
*Others were round or irregular; # none of the features (i,e post acoustic enhancement or shadowing) were seen in 6 cases

Sonomammographic lesion	FNA/HPR diagnosis		Total	p-value
	Malignant	Benign		
Malignant	21 (91.3%)	2 (8.6%)	23 (100.0%)	<0.001(s)
Benign	1 (2.8%)	34 (97.1%)	35 (100.0%)	
Total	22 (37.9%)	36 (62.1%)	58 (100.0%)	

[Table/Fig-9]: Comparison of sonographic characterisation with histopathology.

Combined imaging and histopathology were concordant in 92% (n=23) of cases assessed as malignant and 100% (n=35) in benign category [Table/Fig-10]. Sensitivity, specificity, PPV, NPV and Diagnostic accuracy of mammography, Sonography and Combined Imaging is shown in [Table/Fig-11].

Lesion	FNA/HPR diagnosis		Total	p-value
	Malignant	Benign		
Malignant	23 (92.0%)	2 (8.0%)	25 (100.0%)	<0.001(s)
Benign	0 (0.0%)	35 (100.0%)	35 (100.0%)	
Total	23 (38.3%)	37 (61.7%)	60 (100.0%)	

[Table/Fig-10]: Comparison of combined mammographic and sonomammographic characterisation with histopathology.

DISCUSSION

Palpable breast mass is the most common clinical presentation of various breast pathologies ranging from benign cyst to malignancy and among the palpable lesions undergoing biopsy, many lesions turned out to be benign. Thus, differentiation of benign and malignant masses is needed for proper management and to avoid unnecessary breast biopsies.

Reliability	Modalities		
	Mammography	Sonography	Combined imaging
Sensitivity (%)	94.7	95.4	100
Specificity (%)	93.9	94.4	94.6
PPV (%)	90	91.3	92
NPV (%)	91.2	97.1	100
Diagnostic accuracy	94.2	94.8	96.6

[Table/Fig-11]: Accuracy of imaging modalities with respect to histopathology.

Mammography is the only screening modality, which has been proven to reduce mortality from breast cancer through early detection.The role of mammography in patients with palpable breast lumps is to rule out malignancy and screen for additional lesions. Sonography is used as an adjunct to mammography to further evaluate palpable masses, especially in women with dense breasts.

The mammographic features of irregular shape, spiculated/ill-defined margins, microcalcification, axillary lymphadenopathy, skin thickening/retraction and nipple retraction were more frequently seen in malignant lesions than benign and were individually statistically significant for depiction of a malignant mass. This correlated well with the study done by Gurung G et al., who found lobular and irregular shape, spiculated and indistinct margins, punctuate and polymorphic calcifications to be the features of malignant lesions, with secondary signs of architectural distortion, nipple retraction and skin thickening [3]. In another study by Mendez A et al., 83% of malignant cases had microcalcification and 73% had spiculated margins [4]. The mammographic features of oval/round shape, circumscribed margins, presence of radiolucent halo around the mass and macro-calcification were more frequently seen in benign than malignant lesions and this correlated well with the study done by Gurung G et al., and Hong AS et al., [3,5]. Changes like axillary lymphadenopathy, nipple retraction and increased skin thickness were found only in malignant cases, which are concordant with the results of Gurung G et al., [3]. Gurung G et al., also showed that 'Halo sign' was found only in benign cases which correlates with present study [3].

Of the 52 cases, 32 were mammographically benign and 20 malignant. Both mammographic and pathologic diagnoses were concordant in 18 (90%) malignant and 31(96.8%) benign cases. Among three discrepant lesions, two were mammographically malignant and subsequent pathology revealed it to be benign (Benign phyllodes and Adenomyoepithelioma). One mammographically benign lesion was malignant (papillary carcinoma) at pathological examination.

In the present study, the sensitivity of mammography was 94.7% and specificity was 93.9%, which is comparable to the study by Gurung G et al., where the sensitivity of mammography was 88.89% and specificity 95.53%.

Thirty nine of the 58 sonographically detected lesions were solid and rest were cystic or predominantly cystic lesions. The cystic lesions included simple cysts (n=8), clustered cysts (n=1), complicated cysts with internal echoes or thin internal septations (n=8), cyst with thick septations (n=1) and cyst with intra-cystic solid nodules (n=1). Two of the 19 cystic lesions turned out to be malignant and the rest were benign on histopathology. This correlated well with the study by Berg WA et al., and Chang YW et al., [6,7].

In the 39 solid/predominantly solid masses, almost equal distribution of benign (n=19) and malignant (n=20) cases was noted. The sonographic features of irregular shape, spiculated/ill-defined margins, anti-parallel orientation, posterior acoustic shadowing, vascularity with a RI >0.7 and axillary lymphadenopathy were more frequently seen in malignant lesions than benign and were individually statistically significant for depiction of a malignant mass. The features of oval shape, circumscribed margins, parallel orientation, posterior acoustic enhancement were more frequently seen in benign than malignant lesions and were individually statistically significant for depiction of a benign mass. However, the echo pattern of masses and presence of calcification were not significant in characterizing the palpable masses. This correlated well with the study by Hong AS et al., and Okello J et al., [5,8].Posterior acoustic features and association with axillary lymph nodes were reliable in differentiating benign and malignant lesions in the present study, which is contradictory to the Okello J et al., [8].

Rahbar G et al., established that few sonographic features can help in differentiation of benign and malignant masses [9]. The results of the present study are in close correlation with the above study, except for the mass echo pattern. In the present study, the association of sonographic features with benign and malignant masses were as like that achieved by Gonzaga MA [10].

In a sonographic review of 178 breast masses by Costantini M et al., it was concluded that typical signs of malignancy were irregular shape, antiparallel orientation, non-circumscribed margin, echogenic halo, and decreased sound transmission while the typical signs of benignity were oval shape and circumscribed margin [11].

Of the 39 solid masses, 4 benign and 16 malignant cases were vascular. All the cases with RI>0.7 were malignant, but RI <0.7 was found almost in equal incidence in benign (n=4) and malignant category (n=5). The sensitivity of RI value for detecting malignancy is 68.75% and specificity being 100.0%. This is in correlation with the study by Schmillevitch J et al., [12]. In another study by Del Cura JL et al., colour flow was more frequently seen in malignant than in benign lesions, but sensitivity, specificity, and positive and negative predictive values for this sign were low [13].

In the present study, two cases were falsely reported as sonographically normal and thus were assigned BIRADS category 1. All the cases categorized as BIRADS 2 and 94.1% as BIRADS 3 were concordant on histopathology while one case in BIRADS 3 turned out to be malignant. One case each in BIRADS 4 and BIRADS 5 were histopathologically benign.

Of the 58 cases, 35 were sonographically benign and 23 malignant. Both sonographic and pathologic diagnoses were concordant in 21 (91.3%) malignant and 34 (97.1%) benign cases. Among three discrepant lesions, two were sonographically malignant and subsequent pathology revealed it to be benign (Benign phyllodes and Adenomyoepithelioma). One sonographically benign lesion was malignant (mucinous carcinoma) at pathological examination.

In the present study, the sensitivity of sonography was 95.4% and specificity was 94.4%, which was comparatively better than the study by Gonzaga MA, where the sensitivity and specificity of sonography was 57.1% and 62.8% [10].

The sensitivity, specificity, positive predictive value and negative predictive value of mammography were 94.7%, 93.9%, 90% and 91.2% respectively, which are comparable to the studies by Gurung G et al., and Shrestha MK et al., [3,14].

The sensitivity, specificity, positive predictive value and negative predictive value of sonography were 95.4%, 94.4%, 91.3% and 97.1% respectively, which are comparable to the studies by Gonzaga MA et al., Costantini M et al., and Paulinelli et al., [10,11,15].

The diagnostic accuracy of imaging in a patient presenting with palpable mass in the breast, increases after inclusion of sonography to mammographic studies, as sonography characterizes palpable lesions obscured by dense tissue on mammograms and better delineates the internal contents of the lesions. Also, mammography acts as an adjunct to sonography in better detection of presence and pattern of calcification. In the present study, concordance of combined mammographic and sonographic diagnosis and histopathology was achieved in 23 (92%) malignant and 35 (100%) benign cases with increased sensitivity and specificity as compared to the mammography and sonography independently.

Combined mammographic and sonographic assessment was shown to be very helpful in a study by Shetty MK et al., where the combined evaluation showed sensitivity, negative predictive value of 100.0% and specificity of 80.1% [16]. In another study by Taori et al., the specificity of mammography and sonography in detection of malignancy were 93.3% and 86.6% respectively, which increased to 97% on combined imaging [17]. Similar results were noticed by Jaipal RB et al., and Zonderland HM et al., [18,19].

LIMITATION

The main limitation of our study was small sample size.

CONCLUSION

Imaging has an important role in the management of palpable masses of the breast. Combined use of mammography and sonomammography is appropriate in most instances to better characterize palpable lesions and thus helps to reduce the patient anxiety and avoids unnecessary interventions in those cases in which imaging findings are unequivocally benign. Diagnostic accuracy of combined mammographic and sonographic imaging is very high and is reassuring to the patient.

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