DIAGNOSTIC ACCURACY OF MAMMOGRAPHY AND ULTRASONOGRAPHY FOR BREAST DISEASES

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BACKGROUND

Detecting the breast pathologies, at its earliest possible stage is the ultimate goal in imaging the breast. Diagnosis chiefly includes radiological investigations like mammography and ultrasonography followed by biopsy. The incidence of breast cancer deaths can be reduced by 30% by the routine screening of healthy women with mammography. USG plays a key role in differentiating solid and cystic masses. It is useful in the evaluation of palpable masses not visible radiographically.

ABSTRACT

The purpose of this study was to compare the role of mammography and ultrasonography in the evaluation of breast diseases and to compare the diagnostic accuracy of ultrasonography and mammography for diagnosing breast diseases when doing individually and its combination on same patients.

MATERIALS AND METHODS

Data for this descriptive study were sourced from all female patients above 15 years of age who presented with symptoms of breast diseases like breast lump, pain in the breast and nipple discharge to outpatient and inpatient surgery department in SRM Medical College Hospital and Research Centre, Kattankulathur during the period from June 2013 to May 2016. Data collection methods include direct interview, clinical examination, mammography and ultrasonogram of symptomatic breast followed by FNAC (Fine Needle Aspiration Cytology) in all patients and excision biopsy in selected cases. Then the reports of FNAC/histopathological examinations were compared with the results of mammography and ultrasonogram of breast.

RESULTS

According to this study, MG showed a sensitivity of 82.6% compared to 73.9% for USG in detecting fibroadenoma. However, their combined approach resulted in 95.7%. In case of fibrocystic disease MG showed 27.6% and USG only 75.9% and the combination resulted in 75.9%. For diagnosing carcinomas MG had a sensitivity of 83.3% and USG 73.3%, but the combination had an efficiency of 100%. Overall, the histopathological results when correlated with each modality finding showed that MG had an efficiency of only 61.3% and USG only 77.4% when used alone in detecting these lesions of the breast compared to an efficiency of 91.2% obtained by their combined approach. Positive predictive value of ultrasonogram and mammogram was 98.6% and 100% respectively. Negative predictive value for USG and MG was 22.2% and 15.2% respectively with the accuracy rate of 78% for USG and 61% for MG.

CONCLUSION

Mammogram and ultrasonogram are two important non-invasive investigations available for evaluating breast diseases. Mammogram is more efficient in diagnosing malignant diseases of the breast, while ultrasonogram is more efficient in diagnosing benign breast diseases. The combinations of ultrasonogram and mammogram will diagnose almost all diseases of the breast. By using these non-invasive diagnostic modality, unnecessary invasive procedures like FNAC biopsy can be avoided.

KEYWORDS

Mammography, Ultrasonography, FNAC, Breast Cancer, Breast Evaluation.

HOW TO CITE THIS ARTICLE: Chakkarapani R, Durairaj B. Diagnostic accuracy of mammography and ultrasonography for breast diseases. J. Evolution Med. Dent. Sci. 2018;7(05):592-596, DOI: 10.14260/jemds/2018/135

BACKGROUND

Detecting the breast pathologies, at its earliest possible stage is the ultimate goal in imaging the breast. Diagnosis chiefly includes radiological investigations like mammography and ultrasonography followed by biopsy. The incidence of breast cancer deaths can be reduced by 30% by the routine screening of healthy women with mammography.

Financial or Other Competing Interest': None. Submission 20-12-2017, Peer Review 13-01-2018, Acceptance 19-01-2018, Published 29-01-2018. Corresponding Author: Dr. Rajesh Chakkarapani, No. 5/3, Muthu Street Krishnapuram, Gingee-604202, Villupuram District. E-mail: drrajesh83@gmail.com DOI: 10.14260/jemds/2018/135 This is because breast changes like asymmetry, neodensity, distortion of fibroglandular architecture and microcalcifications are picked up earlier than lesions that become clinically palpable or are sometime detected by self examination.^{1,2} USG plays a key role in differentiating solid and cystic masses. It is useful in the evaluation of palpable masses not visible radiographically; dense breasts, abscesses and masses that are not completely evaluable with mammogram and in young patients susceptible to radiation damage. Both mammogram and ultrasonogram methods have been used in attempts to reduce the negative-to-positive biopsy ratio.³

Objectives of the Study

To compare the diagnostic accuracy of mammography and ultrasonography for various breast diseases when doing independently and its combination.

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MATERIALS AND METHODS

Data for this descriptive study was sourced from hundred female patients above 15 yrs. of age who presented with breast lump, pain in the breast and nipple discharge and willing to undergo mammogram, ultrasonogram and treatment for their breast disease in outpatient and inpatient surgery department in SRM Medical College Hospital and Research Centre, Kattankulathur during the period from June 2013 to May 2016 were included as study subjects. Patients with recurrent breast lumps and postoperative case of breast diseases were excluded. After taking the informed consent, data was collected by direct interview. Clinical examination of all systems and local examination of breast and then all patients were subjected to mammogram and ultrasonogram of symptomatic breast. Patients were then subjected to FNAC (Fine Needle Aspiration Cytology) followed by excision biopsy in selected cases. Then the reports of FNAC/Histopathological examinations (Gold Standard) were compared with the results of mammography and ultrasonogram of breast. Data analysis was done using SPSS 16.0 version. Descriptive statistics were calculated in percentages. Sensitivity, specificity, positive predictive value and negative predictive value were expressed as percentages.

RESULTS

Based on the histopathology report, 93 patients were found to be suffering from breast diseases. Ductal carcinoma, fibrocystic diseases, fibroadenoma and mastitis were reported in 30 patients, 29 patients, 23 patients and 9 patients respectively. Also, galactocoele and lactational adenoma was reported in one patient each. Out of the 93 female participants with breast diseases the sensitivity of ultrasonogram was found to be 73.9%, 73.3% and 75.8% in finding fibroadenoma, ductal carcinoma and fibrocystic diseases, respectively. Also 100% sensitivity was found in galactocele, lactational adenoma and mastitis. Sensitivity of mammogram was found to be 82.6%, 83.3%, 27.5% and 22.2% in finding fibroadenoma, ductal carcinoma, fibrocystic diseases and mastitis respectively. Sensitivity of combining ultrasonogram and mammography was found to be 95.7% and 75.9% in finding fibroadenoma and fibrocystic diseases, respectively. Also 100% sensitivity was found in ductal carcinoma, galactocoele, lactational adenoma and mastitis (Table 1).

Diagnosis	Total	USG	Sensitivity (%)	MG	Sensitivity (%)	USG + MG	Sensitivity (%)
Fibroadenoma	23	17	73.9	19	82.6	22	95.7
Ductal Carcinoma	30	22	73.3	25	83.3	30	100
Fibrocystic Disease	29	22	75.8	8	27.5	22	75.9
Galactocele	1	1	100	0	0	1	100
Lactational Adenoma	1	1	100	0	0	1	100
Mastitis	9	9	100	2	22.2	9	100
Total	93	72	77.4	54	58.06	85	91.4
Table 1. Ultrasonogram and Mammogram Diagnoses in various Breast Diseases							

Ultrasonogram detects the lesion by the features of shape, margin, echogenicity, homogenicity, compressibility, posterior enhancement and calcifications. Ultrasonogram clearly differentiate carcinoma from benign disease with the features of irregular margin and shape, anechoic or mixed echogenicity and distorted architecture of surrounding breast parenchyma and evidence of microcalcification noted. The real advantage of USG was that solid and cystic masses could be differentiated well and young breasts with dense fibroglandular parenchyma could be imaged with ease. Number of cases with specific USG findings were given in Table 2.

HPR	Fibroadenoma	Fibrocystic Disease	Mastitis	Carcinoma	Galactocele	Lactational Adenoma	
No. of Cases Diagnosed	17	22	9	22	1	1	
Shape	Oval (17)	Irregular (20) Diffuse (2)	Oval (7) Irregular (2)	Irregular (22)	Irregular (1)	Oval (1)	
Margin	Round (17)	Irregular (22)	Irregular (2) Round (7)	Irregular (22)	Round (1)	Round (1)	
Echogenicity	Hypoechoic (17)	Hypoechoic (21)	Hypoechoic (7)	Anechoic (6) Mixed Echogenicity (16)	Hypoechoic (1)	Hypoechoic (1)	
Calcification	Coarse Cal+ (3)	-	-	Microcal + (16)	-	-	
Homogenicity	Uniform (17)	Uniform (6) Mixed (16)	Uniform (7)	Mixed (22)	Uniform (1)	Uniform (1)	
Compressibility	No	No	Yes	No	Yes	No	
Posterior Enhancement	Yes	No	Yes	No	No	Yes	
Table 2. Ultrasonogram Findings in various Breast Diseases							

According to mammogram, the lesions were analysed on the basis of their location (relation to their quadrant), number of asymmetrical lesions, well defined or merging with the adjacent normal breast tissue, density of the lesion, margins, surrounding halo, the presence or absence of intramammary and axillary lesions, classified according to BIRADS classification. Number of cases with specific MG findings were given in Table 3.

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HPR	Fibroadenoma	Fibrocystic Disease	Mastitis	Carcinoma		
Number of Cases	19	8	2	25		
Density	Increased (19)	Increased (8)	Increased (2)	Increased (25)		
Margin	Round (19)	Irregular (8)	Irregular (1) Round (1)	Irregular (25)		
Calcification	Coarse Cal+(3)	-	-	Microcal+(23)		
Architecture	Normal	Normal	Normal	Asymmetrical (17)		
Fibroglandular	Normal	Normal	Normal	Normal		
Skin Thickness	Normal	Normal	Normal	Increased (2)		
BIRADS	2	2	2	4, 5		
Table 3. Mammogram Findings in various Breast Diseases						

According to this study, MG had a sensitivity of 27.6% compared to 75.9% for USG for detecting fibrocystic disease, but their combined approach resulted in 75.9%. In diagnosing fibroadenomas, MG showed 82.6% sensitivity and USG 73.9% and the combination 95.7%. For carcinomas, MG had a sensitivity of 83.3% and USG 73.3%, but the combination had a sensitivity of 100%.

USG	Disease Present	Disease Absent	Total		
Positive	72	01	73		
Negative	21	06	27		
Total 93 07 100					
Table 4. Diagnostic Accuracy of USG in Detecting all Breast Diseases					

Sensitivity= 77.4 (67.9 - 84.7) Specificity= 85.7 (48.7 - 97.4) PPV= 98.6 (92.6 - 99.7) NPV= 22.2 (10.6 - 40.7) Efficiency= 78 (68.9 - 85.0)

MMG	Disease Present	Disease Absent	Total		
Positive	54	00	54		
Negative	39	07	46		
Total 93 07 100					
Table 5. Diagnostic Accuracy of Mammography in					
Detecting all Breast Diseases					

Sensitivity= 58.06 (47.7 - 67.8) Specificity= 100 (64.6 - 100) PPV= 100 (93.4 - 100) NPV= 15.2 (7.6 - 28.2) Efficiency= 61 (51.2 - 69.9)

Overall, the histopathological results when correlated with each modality findings revealed that MG had a sensitivity of 61.3% and USG 77.4% when used alone in detecting these lesions of the breast compared to a sensitivity of 91.2% obtained by their combined approach. The ultrasonogram had a specificity of 85.7%, whereas mammogram had a specificity of 100%. It means false positive was 0 in our study. Positive predictive value of ultrasonogram and mammogram was 98.6% and 100% respectively. Negative predictive value for USG and MG was 22.2% and 15.2% respectively with the accuracy rate of 78% for USG and 61% for MG.

This study showed that there was no significant difference in sensitivity between MG and USG in case of fibroadenoma (p= 0.72) and carcinoma (p= 0.53), but there

was a significant difference between MG and USG in case of fibrocystic disease (p= 0.001).

There was a significant difference between when USG alone and combination of USG and MG in case of carcinoma (p=0.005). Similarly, significant difference present when doing MG alone and combination of MG and USG in case of fibrocystic diseases (p=0.001).

Number of Cases					P value		
Diagnosis	FNAC	USG	MG	USG+ MG	USG and MG	USG and USG+MG	MG and USG+MG
Fibroadenoma	23	17	19	22	0.72	0.10	0.34
Ductal Carcinoma	30	22	25	30	0.53	0.005 *	0.052
Fibrocystic Disease	29	22	8	22	0.001	1.0	0.001*
Table 6. Statistical Evaluation of							
USG/Mammography/FNAC in Detecting Breast Diseases							

Fisher's exact test *statistically significant.

DISCUSSION

Breast cancer is one of the most prevalent cancers in the world among women and is the second most common cancer in Indian women. Of all breast disorders, palpable breast lump is the second most common presentation, pain being the first.

Breast problem could be as simple as breast abscess to as ominous as cancer.⁴ The breast lump besides creating anxiety may result in carcinoma and causes unbearable pain and deformity. Benign breast disease is so common that over half of the female population at some time in life seeks medical advice for breast problem, but effective evaluation and prompt diagnosis was needed to rule out malignancy. An early accurate diagnosis of breast disease has a favourable prognosis than that of late detection.⁵

For evaluation of breast disease, the most common imaging modality ultrasonography and mammography are used. Both have been used in an attempt to reduce the negative to positive biopsy ratio. The spectrum of breast diseases is different in young females and what brings a young girl to a doctor is no more than Anomaly of Normal Breast Development and Involution (ANDI). The term ANDI implies that most breast disorders are only physiological extremes. Both ultrasonography and mammography can reduce the unnecessary invasive procedure for most of the benign breast diseases in young women.⁶

Mammography, the primary method of detection and diagnosis of breast disease has a proven sensitivity of 85% - 95%. In our study, the sensitivity of mammography for carcinoma is 83.3%. Breast lump whether symptomatic or

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asymptomatic are frequently diagnosed by mammography. High quality mammogram screening can be considered a major public health achievement, as it reveals the various types of lesions in the breast apart from assessing the breast density. Mammography is, therefore, the gold standard for early detection of breast cancer.⁷

Ultrasonography (USG) is the ideal imaging modality and can be useful in identifying and characterising breast masses by certain criteria and then guiding further investigations. Ultrasonography is of great value for breast disease detection in young. Previously, the use of ultrasonography was restricted to differentiation of cystic and solid masses. Today, ultrasonography can be used to further characterise a lesion and to guide interventional procedures. In addition, the roles of ultrasonography in differentiating benign and malignant lesions are excellent. Because of the easy availability of ultrasonogram, it is considered as one of the best noninvasive investigations for evaluating breast diseases.⁸

Ultrasonography often detects cysts or solid lesions that are obscured on the mammogram by the surrounding fibroglandular tissue and can reduce the number of surgical biopsies required when cysts are identified. Sonographic findings can often confirm a cancer that is obscured mammographically by dense breast tissue. Sonographic technology for breast imaging has dramatically improved in the last decade. With further improvements in sonographic technology and careful prospective real-time evaluation of palpable breast lumps, perhaps the negative predictive value will one day approach 100%, ideally providing complete confidence for follow-up rather than recommending biopsy of these lesions.⁹

Study done by Varela et al¹⁰ was able to show the various impact of different approaches used, such that mammography was capable of detecting 94.5% of breast carcinomas; breast sonography detects 91% and palpation detects 87%. However, combinations of these approaches such as mammography and sonography or mammography and palpation detected 99% of carcinomas, while sonography and palpation detected 95% of carcinomas. Nevertheless, ultrasound is significantly more accurate in determining tumour size.¹¹

A study done by Sachin Prasad N and Dana Houserkova¹² in 2007 showed that mammography had a sensitivity of 82% for fibrocystic disease detected, 18 cases out of 22. Our study showed sensitivity of 27.5% detected, 8 cases out of 29, remaining 21 cases were missed in mammography. In our study most of the patients diagnosed of fibrocystic disease are in the younger age group, hence dense fibroglandular breast had less sensitivity to mammogram.

Mammography is most sensitive for carcinoma. Sachin N study diagnosed 7 cases out of 9, which showed sensitivity of 77%. Similarly, our study also showed higher sensitivity of 83.3% for carcinoma diagnosed, 25 cases out of total 30. The high sensitivity of mammogram to carcinoma was due to its characteristic microcalcification, spiculation and architectural distortion. Hence, it can diagnose non-palpable carcinoma even in asymptomatic women.¹³ For fibroadenoma, the sensitivity was about 75% in Sachin Prasad N study who detected 12 cases out of 16. In our study the detection rate was 82.6%, 19 cases detected out of 23. Mammography had high sensitivity for fibroadenoma because of its characteristic appearance like well-defined borders and increased density

with normal surrounding parenchyma. Mammogram had low sensitivity for mastitis, because of its diffuse location and ill-defined margin sometime mimic carcinoma.¹⁴

Similarly, ultrasonogram shows 95% sensitivity for fibrocystic disease, whereas our study shows only 75.9% sensitivity. For mastitis, the sensitivity is 100% in both studies. Mastitis was characterised by irregular borders, homogenously hypoechoic with internal septations and moving debris. In our study, USG had a higher sensitivity for fibroadenoma, i.e. 73.9% compared to that of Sachin Prasad N (31%). Detection of malignancy when doing USG alone is 55%, whereas our study shows 73.3%. When doing USG alone for breast diseases, it had a high sensitivity for infective pathology (mastitis) but had a low detection rate for carcinoma. The variations in the sensitivity may be due to operator dependence of the ultrasonogram.¹⁵

The sensitivity for diagnosing both benign and malignant diseases was very high in case of combined modality of both ultrasonogram and mammogram in the same patients than doing either of the one alone. For example, in case of carcinoma the sensitivity for ultrasonogram was 73.3% and for mammogram alone was 83.3%, but the combined sensitivity was 100%. This was due to cases that were missed by mammogram were picked up by ultrasonogram or cases missed by ultrasonogram were picked up by mammogram, thus the combined sensitivity showed high when compared to the individual sensitivity.¹²

The sensitivity and specificity for benign and malignant disease when doing ultrasonogram alone in different studies were shown in the table. The sensitivity of ultrasonogram for carcinoma in all studies were high when compared to our studies. This may be due to the fact that ultrasonogram was operator dependent, but when it was done by experienced radiologist it increases both the sensitivity and specificity. Similarly, for benign disease shows high sensitivity in other studies and also in our study.¹⁶

Mammogram can help the surgeon to determine whether a lesion is potentially malignant and also screen for occult disease in the surrounding tissue. Radio-opaque ball bearings mark the location of the mass and spot compression and magnification views can clarify the breast mass and determine its density.¹⁷ If old films are available, they are compared with the new images. USG can effectively distinguish solid masses from cysts, which account for approximately 25 percent of breast lesions. When strict criteria for cyst diagnosis are met, USG has a sensitivity of 89 percent and a specificity of 78 percent in detecting abnormalities in symptomatic women. Recurrent or complex cysts may signal malignancy; therefore, further evaluation of these lesions is required. Although, USG is not considered a screening test, it is more sensitive than mammogram in detecting lesions in women with dense breast tissue.¹⁸ It is useful in discriminating between benign and malignant solid masses and it is superior to mammogram in diagnosing clinically benign palpable masses.14 It was found from the literatures that MG is a well-established diagnostic modality for the breast. MG when combined with USG can yield significant improvement in accuracy rates.¹⁹

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CONCLUSION

Mammogram and ultrasonogram are two important noninvasive investigations available for evaluating breast diseases. Mammogram is more efficient in diagnosing malignant diseases of the breast, whereas Ultrasonogram is more efficient in diagnosing benign breast diseases. The combinations of ultrasonogram and mammogram will diagnose almost all diseases of the breast. By using these noninvasive diagnostic modality unnecessarv invasive procedures like FNAC biopsy can be avoided. Both ultrasonogram and mammogram can be repeated in case of patients having persistent symptoms of breast diseases. Hence, ultrasonogram and mammogram should be used for confirming the clinical diagnosis of the breast diseases and they can be gold standard investigations for breast diseases in future days.

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