

A Comparative Study of Mammography versus Ultrasonography in the Triple Assessment of a Breast Lump

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Abstract

Background and Objectives: Multiple studies have been part taken in to facilitate easy and early diagnosis along with appropriate and timely intervention. Tiered approaches to diagnosis like triple assessment have been formulated to use diagnostic modalities in stepwise manner. This study aims at understanding two such diagnostic tools – ultrasonography and mammography and their comparison with each other.

Methods: This was a study conducted at ESICMC & PGIMSR between JANAUARY 2018 TO JUNE 2019, including female patients above 30 years of age that were chosen on the basis of the inclusion and exclusion criteria. Detailed history taken and clinical examination done followed by the diagnostic tests including USG, mammography and FNAC and HPE. Based on the diagnosis, further management was initiated if need be. Statistical analysis done by Chi-square.

Results: USG as a diagnostic test showed a sensitivity of 94.3%, specificity of 93%, PPV of 91.6%, NPV of 95.2% and accuracy of 93.5% while Mammography showed a sensitivity of 77.1% with specificity of 83.7%, PPV of 79.4% and NPV of 81.8% and an accuracy of 80.7%. USG was shown to be superior to mammography in the diagnosis of a breast lesion ($p = 0.025$).

Interpretation and Conclusion: Taking HPE as a 100% accurate tool, the accuracy and ability of the two modalities were tested where in, USG takes a precedence over Mammography in not just recognizing the malignant but also eliminating the benign.

Keywords: ultrasonography, mammography, triple assessment.

Introduction

The Breasts are the pair of modified sweat glands derived from ectoderm, located in the anterior chest wall.¹ Breast carcinoma is the second most common cancer in India next to carcinoma cervix. It is a leading cause for death from cancer for the women aged between 20-50years worldwide.

Worldwide, about 29 percent of new cases are diagnosed cases which accounts to 14% of the cancer related deaths in in women.² In India, Breast cancer is ranked number one by having incidence as high as 25.8 per 100,000 women and mortality of 12.7 per 100,000.³ In India, incidence begins in early thirties and peaks at 50-64 years age.

The most common presentation of breast cancer is LUMP in the Breast . Fortunately, most of the times the breast lumps are benign in etiology, but this should not undermine or neglect the incidences of malignant etiology

which could land the patient in unnecessary disease burden and clinician in malpractice litigation. Definitive diagnosis of a breast lump not only reduces the physical, psychological and emotional trauma, but also for surgeon to decide the treatment and reduces the burden over the health care services.

Triple assessment of the breast lump - clinical assessment, radiologically (ultrasonography / mammography) and pathologically (fine needle aspiration cytology/ trucut biopsy) are collectively needed for the diagnosis of a breast lump. Even though the gold standard diagnostic tool is histopathological report, the most accepted is **Triple Assessment** as it is cost effective, simple, reliable, reproducible, less invasive, less traumatic, less disturbing to the patient and can be done in outpatient basis. Due to certain limitations of the mammography like insufficient visual exposure and not being conventional for dense breasts can lead to missing of the diagnosis. This study is made to compare the utility of the ultrasonography versus mammography in the detailed evaluation of the breast lump as a part of triple assessment and hence overall diagnostic outcome of triple assessment.

Methodology

The present study was conducted in the department of General Surgery, ESIC Model hospital attached to ESIC medical college & PGIMS, Rajajinagar, Bengaluru from January 2018 to June 2019 between the groups of hand sewn and stapler anastomosis.

Method of Collection of Data

Patients satisfying inclusion criteria are enrolled after informed consent. All the patients will be evaluated with thorough clinical examination, radiological (both Ultrasonography and Mammography) and FNAC of the Swelling.

Study Period: January 2018 To June 2019

Study Design: A Comparative Study

Sample Size: The sample size for the present study has been calculated by considering the difference between the positive predictive values (PPV) of the clinical examination and ultrasonography as 75% & 93% respectively from the past published literature. The minimum sample size has been calculated as 51 cases with 0.18 as effect size which will ensure at least 80% power of the study at 5% level of significance assuming one tailed hypothesis. Following formula has been used to calculate the sample size:

$$n = \frac{[Z_{\alpha} \sqrt{2 * PPV(1-PPV)} + Z_{\beta} \sqrt{PPV_1(1-PPV_1) + PPV_2(1-PPV_2)}]^2}{(PPV_1 - PPV_2)^2}$$

Where, $Z_{\alpha} = 1.645$, $Z_{\beta} = 0.8416$, $PPV = 0.84$, $PPV_1 = 0.75$, $PPV_2 = 0.93$ and PPV is the mean of PPV_1 and PPV_2 .

Place of Study: The present study will be conducted in the Department of General surgery, ESIC Model Hospital, ESIC MC & PGIMS, Rajajinagar, Bangalore – 10

Inclusion Criteria

- All patients with clinically palpable lump in the breast of age more than 30yrs.

Exclusion Criteria

- Pregnant women
- Breast abscess
- Fungating mass
- Cystic lesions (confirmed by ultrasonography)

Institutional Ethical Committee approval to conduct the study was obtained prior to the commencing enrolment of patients.

Statistical Analysis

Data will be analyzed using appropriate descriptive and inferential statistics. The categorical type data like growth type (benign and malignant), under malignant various risks categories etc will be expressed in terms of frequencies and percentages whereas the numeric

continuous data like patient’s age, biochemical markers as mean ± SD. After obtaining the results from the clinical examination, ultrasonography, mammography and FNAC independently, all diagnostic indicators like Sensitivity, Specificity, PPV, NPV, positive likelihood (LR+) and negative likelihood (LR-) will be calculated for all the tests along with 95% C I considering the HPE as gold standard. To know the reliability of the individual test with respect to gold standard, McNemar Chi-square test will be conducted. And in order to compare the diagnostic indicators of all the tests, Chi-square test will be used. For all statistical evaluations, a two tailed p- value < 0.05 will be considered as statistically significant. Qualitative data will also be summarized using charts and diagrams. Data will be analysed using statistical package SPSS-20.

Results

A total of 78 patients that fell within the inclusion criteria were taken up and subjected to analysis. Results obtained as per the study are given in the following tables. Distribution according to various factors observed have been tabulated and the sensitivity, specificity, PPV, NPV and accuracy calculated.

Table 1: Age distribution of breast lesions

Age groups (in years)	No. of cases	Percentage (%)
30-44	37	47.4
45-54	28	35.9
55-64	8	10.2
>65	5	6.5
Total	78	100

Table 2: Distribution of breast lesions according to the side of involved breast

Side	No of cases	Percentage (%)
Right	49	62.8
Left	29	37.2
Total	78	100

Lesions were observed in right side of breast in 62.8% and left side in 37.2%.

Table 3: Cases diagnosed by HPE and their distribution

Benign/malignant		No of cases	Percentage (%)
Benign (n=43, 55%)	Fibro adenoma	24	31
	Fibrocystic disease	10	11.8
	Benign phyllodes	8	10.4
	Papilloma	1	1.7
Malignant (n=35, 45%)	Lobular carcinoma	12	15.3
	Infiltrating ductal carcinoma/DCIS/ADH	21	26.9
	Papillary carcinoma	2	2.9
Total		78	100

Histopathological examination as the confirmatory tool for the imagine techniques used shows that out of 78 cases, only 45% were actually malignant. Fibroadenomas being the most common.

Chart 1: Distribution of cases diagnosed by HPE

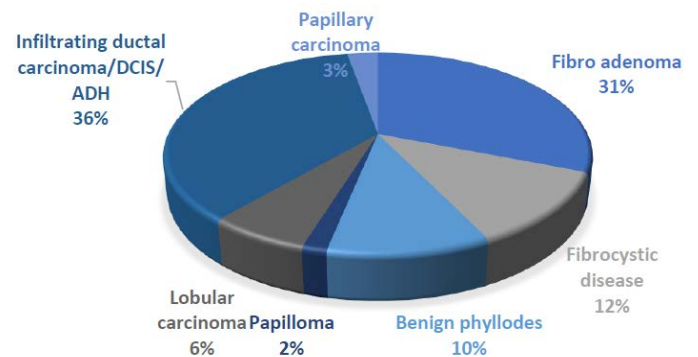


Chart 2: Distribution of malignant cases diagnosed by HPE

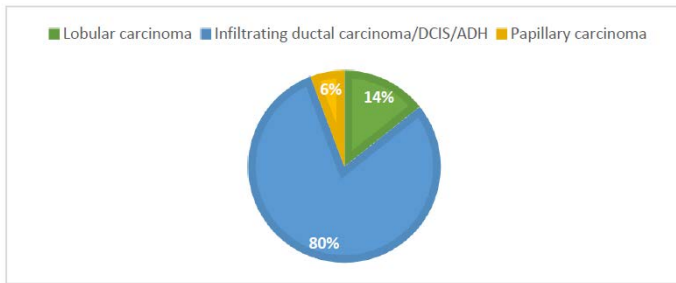


Table 4: Distribution of cases diagnosed by mammography

Cases diagnosed in mammography	No of cases	Percentage (%)
Benign	42	53.8
Suspicious for malignancy	17	21.8
Malignancy	19	24.4
Total	78	100

Out of 78 lesions, mammography indicated 53.8% to be benign and 46.2% to be suspicious of malignancy.

Table 5: Distribution of cases detected by mammography according to BIRADS

Mammographic BIRADS	No of cases	Percentage (%)
I	21	26.9
II	10	12.8
III	11	14.2
IV A	3	3.8
IV B	6	7.6
IV C	9	10.3
V	19	24.4
Total	78	100

Chart 3: Distribution of cases detected by mammography according to BIRADS

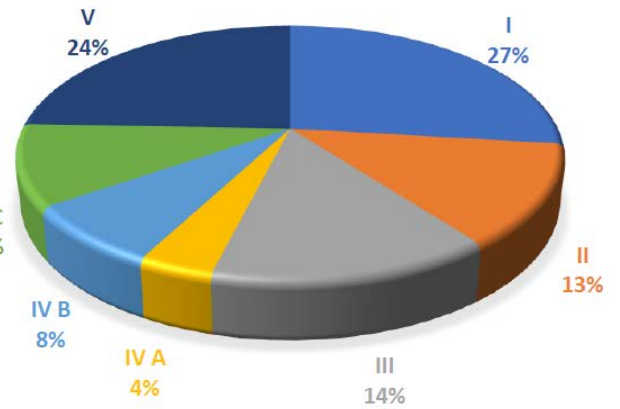


Table 6: Comparison of mammography as a test with HPE

Mammographic inference	HPE		Total
	Benign	Malignant	
Benign	35 (44.8%)	7 (9%)	42 (53.8%)
Suspicious for malignancy/ malignancy	8 (10.3%)	28, (35.9%)	36(46.2%)
Total	43 (55.1%)	35 (44.9%)	78 (100%)

Out of 78 cases, mammography found 42 to be benign and 36 to be suspicious of malignancy/ malignant. Out of the 42 diagnosed benign, 7 were found to be malignant on HPE. Out of the 36 diagnose malignant, only 28 were truly malignant on HPE.

Table 7: Distribution of breast lesions according to quadrant involved observed in mammography with HPE

Quadrants involved	HPE		Total
	Benign	Malignant	
Upper outer	18, 41.8%	20, 57.1%	38, 48.7%
Upper inner	7, 16.2%	8, 22.2%	15, 19.2%
Lower outer	8, 18.8%	1, 2.9%	9, 11.5%
Lower inner	9, 20.9%	2, 5.8%	11, 14.2%
Retro areolar	0	1, 2.9%	1, 1.3%
>1 quadrant	1, 2.3%	3, 8.5%	4, 5.1%
Total	43, 100%	35, 100%	78, 100%

Upper outer quadrant was the most commonly involved amongst both benign and malignant. Out of 38 cases presented with upper outer quadrant mass, 20 were found to be malignant.

Table 8: Shape of lesions distribution as seen in mammography in correlation with HPE

Shape of the lesions	HPE		Total
	Benign	Malignant	
Round	14, 32.5%	3, 8.6%	17, 21.8%
Oval	24, 55.8%	6, 17.1%	30, 38.5%
Irregular	5, 11.6%	22, 62.8%	27, 34.6%
Asymmetrical	0	4, 11.5%	3, 5.1%
Total	43, 100%	35, 100%	78, 100%

Most of the benign lesions were found to be oval (55.8%) while most of the malignant lesions were irregular in shape (62.8%).

Table 9: Distribution according to observed density of lesion by mammography in correlation with HPE

Density of the lesions	HPE		Total
	Benign	Malignant	
Equal	26, 60.5%	5, 14.4%	31, 39.7%
High	15, 34.8%	29, 82.8%	44, 56.5%
Low	2, 4.7%	1, 2.8%	3, 3.8%
Total	43,100%	35, 100%	78, 100%

Out of 44 lesions that exhibited high density, 29 were found to be malignant. 26 of the 31 lesions with equal density were proven to be benign.

Table 10: Distribution of lesions according to margins as seen in mammography with correlation to HPE.

Margins of the lesions	HPE		Total
	Benign	Malignant	
Circumscribed	33, 76.6%	4, 11.5%	37, 47.4%
Spiculated	2, 4.6%	22, 62.8%	24, 30.7%
Obscured	2, 4.6%	4, 11.5%	6, 7.7%
Microlobulated	6, 13.9%	5, 14.2%	11, 14.2%
Total	43, 100%	35, 100%	78, 100%

Most of the benign lesions had a circumscribed margin (76.6%) while most of the malignant lesions showed spiculated margins .

Table 11: Distribution of lesions according to symmetry as seen in mammography with correlation to HPE.

Asymmetry of lesions	HPE		Total
	Benign	Malignant	
Focal	3, 6.9%	24, 68.5%	27, 34.6%
global	0	4, 11.5%	4, 5.1%
Absent	40, 93.1%	7, 20%	47, 60.3%
Total	43, 100%	35, 100%	78, 100%

80% of the malignant were found to show asymmetry while 93.1% of benign showed no asymmetry.

Table 12: Architectural distortion associated with lesions as seen in mammography with correlation to HPE

Architectural distortion	HPE		Total
	Benign	Malignant	
Present	2, 4.6%	26, 74.2%	28, 35.8%
Absent	41, 95.4%	9, 25.8%	50, 64.2%
Total	43, 100%	35, 100%	78, 100%

Architectural distortion was present in 74.2% of the malignant cases while 41 of 43 benign showed no architectural distortion.

Table 13: Calcification as seen in mammography with correlation to HPE

Calcification	HPE		Total
	Benign	Malignant	
Present	9, 20.9%	22, 62.8%	31, 39.7%
Absent	34, 79.1%	13, 37.2%	47, 60.3%
Total	43, 100%	35, 100%	78,100

Calcification was seen in 62.8% of malignant lesions while only 20.9% of the benign lesions showed calcifications.

Tab 14: Distribution of cases showing halo seen in mammography in correlation to HPE

Surrounding halo	HPE		Total
	Benign	Malignant	
Present	38, 88.4%	9, 25.7%	47, 60.2%
Absent	5, 11.6%	26, 74.3%	31, 39.8%
Total	43, 100%	35, 100%	78, 100%

Most of the benign lesions (88.4%) showed presence of a surrounding halo while only 25.7% of malignant showed presence of a surrounding halo on mammography.

Table 15: Distribution of cases diagnosed by USG

Cases diagnosed in USG	No of cases	Percentage (%)
Benign	44	56.4
Suspicious for malignancy	13	16.7
Malignancy	21	26.9
Total	78	100

56.4% of the cases were diagnosed to be benign and 43.6% were diagnosed to be malignant by USG.

Table 16: Distribution of cases detected by sonography according to BIRADS

Sonographic BIRADS	No of cases	Percentage
I	17	21.8
II	13	16.7
III	14	17.9
IV A	5	6.5
IV B	6	7.7
IV C	2	2.5
V	21	26.9
Total	78	100

Chart 4: Distribution of cases detected by sonography according to BIRADS.

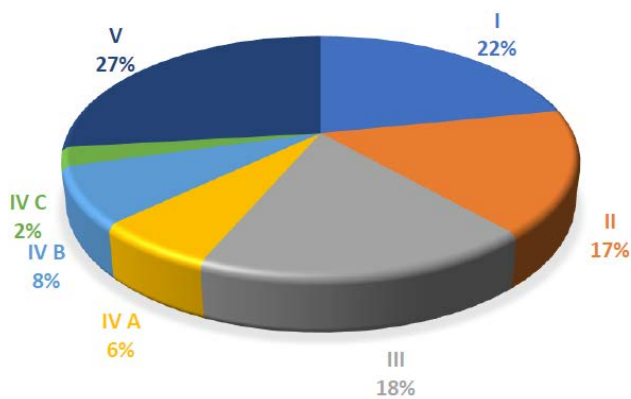


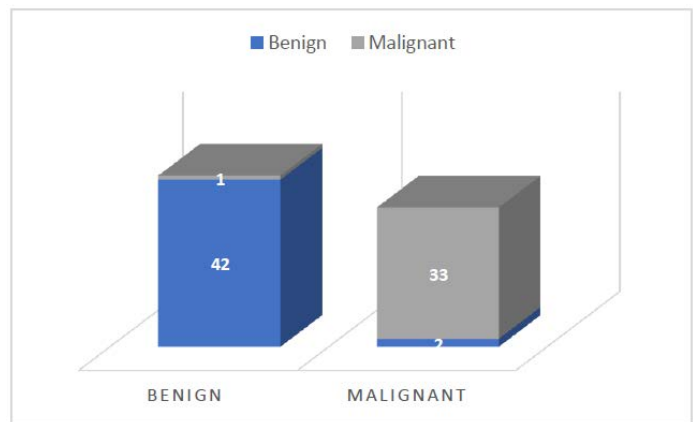
Table 17: Comparison of USG diagnosis with HPE

USG inference	HPE		Total
	Benign	Malignant	
Benign	42, 53.8%	2, 2.6%	44, 56.4%
Suspicious for malignancy/malignancy	1, 1.3%	33, 42.2%	34, 43.5%
Total	43, 55.1%	35, 44.8%	78, 100%

Out of 44 diagnosed benign, 2 were found to be malignant on histopathological examination.

Out of 34 diagnosed malignant only 33 were found to be malignant.

Chart 5: Comparison of USG diagnosis with HPE



Upper outer quadrant was found to be the most involved in both benign (37.3%) as well as malignant (48.5%) lesions.

Table 18: Distribution of according to size of lesions as seen in USG

Size in cm	No. of cases	Percentage(%)
<1cm	5	6.4%
1-2cm	21	26.9%
2-3cm	36	46.2%
3-4cm	9	11.6%
>4 cm	7	8.9%
Total	78	100

Table 19: Distribution of lesions according to involvement of quadrant as detected by USG in correlation to HPE

Quadrants involved	HPE		Total
	Benign	Malignant	
Upper outer	16, 37.3%	17, 48.5%	33, 42.4%
Upper inner	9, 20.9%	6, 17.1%	15, 19.3%
Lower outer	6, 13.9%	4, 11.5%	10, 12.8%
Lower inner	5, 11.6%	2, 5.8%	7, 8.9%
Retro areolar	0	1, 2.8%	1, 1.3%
>1 quadrant	7, 16.3%	12, 14.3%	12, 15.3%
Total	43, 100%	35, 100%	78, 100%

Table 20: Distribution of shape of lesions as seen in USG in correlation with HPE

Shape of the lesions	HPE		Total
	Benign	Malignant	
Round	10, 23.2%	5, 14.3%	15, 19.2%
Oval	26, 60.5%	8, 22.8%	34, 43.5%
Irregular	2, 4.7%	22, 62.9%	24, 30.7%
Linear	5, 11.6%	0	5, 6.5%
Total	43, 100%	35, 100%	78, 100%

Oval shape was the most common, seen in 34 out of 78 patients. 62.9 % of the malignant lesions demonstrated irregular shape.

Table 21: Distribution of orientation of lesions as seen in USG in correlation to HPE

Orientation of lesion	HPE		Total
	Benign	Malignant	
Parallel	31, 72.1%	6, 17.1%	37, 47.4%
Antiparallel	4, 9.3%	27, 77.1%	31, 39.8%
Not applicable	8, 18.6%	2, 5.8%	10, 12.8%
Total	43, 100%	35, 100%	78, 100%

Most of the benign lesions (72.1%) showed parallel orientation to skin while most of the malignant (77.1%) showed anti- parallel configuration.

Table 22: Distribution of orientation as seen in USG in correlation to HPE

Orientation of lesion	HPE		Total
	Benign	Malignant	
Taller than wide	3, 6.9%	19, 54.2%	22, 28.2%
Wider than tall	29, 67.5%	7, 20%	36, 46.2%
Not applicable	11, 25.6%	9, 25.8%	20, 25.6%
Total	43, 100%	35, 100%	78, 100%

29 of the 43 benign lesions were wider than tall while most of the malignant (54.2%) were taller than wide.

Table 23: Distribution of posterior features of lesions as seen in USG in correlation to HPE

Posterior features	HPE		Total
	Benign	Malignant	
No features	7, 16.3%	5, 14.3%	12, 15.4%
Shadowing	5, 11.6%	21, 60%	26, 33.3%
Enhancement	28, 65.2%	2, 5.7%	30, 38.4%
Combined pattern	3, 6.9%	7, 20%	10, 12.9%
Total	43, 100%	35, 100%	78, 100%

Most of the benign lesions (65.2%) showed enhancement while most of the malignant lesions (60%) showed shadowing.

Table 24: Distribution of calcification of lesions as seen in USG in correlation with HPE

Calcification	HPE		Total
	Benign	Malignant	
Present	6, 13.9%	19, 54.3%	22, 28.2%
Absent	37, 86.1%	16, 45.7%	56, 71.8%
Total	43, 100%	35, 100%	78, 100%

Calcification was seen in only 28.2% of cases, 54.3% of malignant cases showed calcification while only 13.9% of benign lesions showed calcifications.

Table 25: Distribution of vascularity of lesions as seen in USG in correlation with HPE

Vascularity	HPE		Total
	Benign	Malignant	
Internal	8, 18.6%	29, 82.8%	37, 47.4%
Rim	4, 9.3%	4, 11.4%	8, 10.2%
Absent	31, 72.1%	2, 5.8%	33, 42.4%
Total	43, 100%	35, 100%	78, 100%

47.4% of the cases showed internal vascularization of lesions while 42.4% showed no vascularity on USG. 12 out of 43 benign lesions showed vascularity of which 4 showed only rim vascularization. 33 out of 35 malignant lesions showed vascularity.

Table 26: Presence lymph nodes associated with lesions as seen in USG with correlation to HPE

Lymph node	HPE		Total
	Benign	Malignant	
Present			
-hilar fat present	12, 27.9%	8, 22.8%	20, 25.6%
-hilar fat absent	1, 2.3%	15, 42.9%	16, 20.6%
Absent	20, 69.8%	13, 34.3%	42, 53.8%
Total	43, 100%	35, 100%	78, 100%

Table 27: Comparison of lesions as diagnosed by clinical breast examination with HPE

Clinical Assessment inference	HPE		Total
	Benign	Malignant	
Benign	41, 52.5%	9, 11.5%	50, 64.1%
Malignancy	2, 2.5%	26, 33.3%	28, 35.9%
Total	43, 55.2%	35, 44.8%	78, 100%

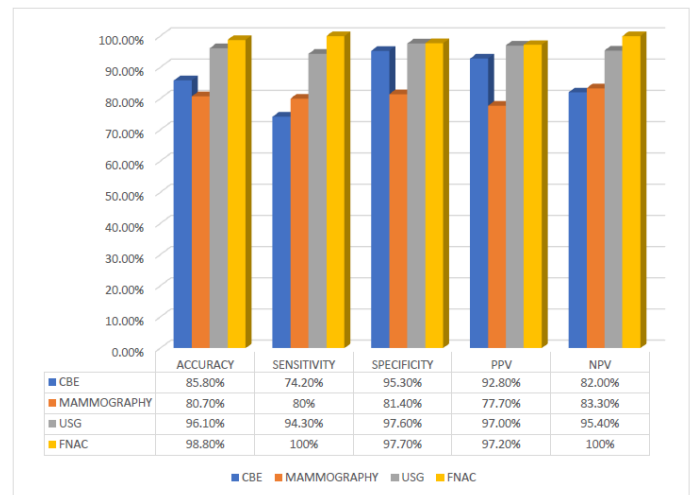
Out of 50 lesions detected to be benign, 9 have were proven to be malignant. Out of 28 diagnosed to be malignant, only 26 were actually malignant.

Table 28: Comparison of lesions as diagnosed by FNAC with HPE FNAC

FNAC	HPE		Total
	Benign	Malignant	
Benign	42, 53.8%	0	42, 53.8%
Malignancy	1, 1.4%	35, 44.8%	36, 46.2%
Total	43, 55.2%	35, 44.8%	78, 100%

None of the lesions diagnosed benign by FNAC were shown to be malignant on HPE, however, 1 lesion detected as malignant by FNAC was proven to be benign on correlation with HPE.

Chart 6: Comparison between Sensitivity, Specificity, PPV, NPV and Accuracy



Comment: USG as a modality for detection of breast cancer in a woman having breast lump showed a sensitivity of 94.30%, specificity of 97.60%, PPV of 97.00%, NPV of 95.40 and an accuracy of 96.10% in comparison to mammography which showed a sensitivity of 80.00%, specificity of 81.40%, PPV of 77.70%, NPV of 83.30% and an accuracy of 80.70%.

Comparison between USG and mammography showed a significant difference in USG and mammography (p= 0.025)

Discussion

Out of 78 patients, 47.4% presented between the age of 30-44 while 35.9% presented between the age of 45-54, 10.2% presented between the age of 55-64 and only 6.5% were above the age of 65. Right Breast was found to be affected in 62.8% of the cases. Histopathology showed 43 of 78 cases to be benign with 31% of them being fibroadenoma while 35 cases were found to be malignant.

1) Clinical breast examination

On Clinical Breast Examination, 28 cases were detected as malignant while 50 cases detected as benign. Out of 28 malignant, only 26 were malignant on correlation with HPE. Out of the 50 diagnosed as benign, 9 were found to malignant on correlation with HPE.

Table 29: Comparison of Sensitivity, specificity, PPV, NPV and accuracy of clinical breast examination with previous studies –5,6,7

Study	Sensitivity	Specificity	PPV	NPV	Accuracy
Chaudhari et al	73.68%	54.86%	50%	77.27%	62.00%
Rajalakshmi et al	86.0%	96.36%	-	88.33%	-
Kharkwal et al	75.0%	83.3%	75%	85%	80%
Jan et al	92.3%	97.8%	80%	99.3%	97.3%
Present study	82.00%	74.20%	95.30%	92.80%	85.80%

These results prove that our study is shows similar diagnostic efficacies as that of previous studies conducted on clinical breast examination.

2) Mammography

Out of 78 cases, mammography assessed 42 to be benign of which 7 were found to be malignant by histopathological reporting. Out of the 36 diagnosed to be malignant, only 28 were proven to be malignant by HPE.

Table 30: Comparison of sensitivity, specificity, PPV, NPV and accuracy of mammography between various previous studies and present study

Study	Sensitivity	Specificity	PPV	NPV	Accuracy
Zeeshan et al	90%	64.5%	89%	90.9%	88.3%
Badu-Peprah et al	73.0%	80.0%	85.2%	65.3%	-
Lehman CD et al	85.3%	91.6%	87.3%	91.4%	-
Present study	80.0%	81.40%	77.70%	83.30%	80.70%

This study showed results similar to previous studies.

3) Ultrasonography

Ultrasonography identified 44 of the lesions to be benign and 34 to be malignant. Of the 34, only 33 were found to be malignant on HPE. Out of the 44 benign lesions, 2 were detected to be malignant.

Table 31 : Comparison of sensitivity, specificity, PPV, NPV and accuracy of USG between various previous studies and present study-5,7

Study	Sensitivity	Specificity	PPV	NPV	Accuracy
Lehman et al	95.75%	89.2%	13.2%	99.2%	-
Ackerman et al	97.4%	66.4%	65%	98%	-
Jan et al	100%	96.4%	66.7%	100%	96.7%
Chaudhari et al	100%	87.10%	82.10%	100%	92%
Present study	94.30%	97.60%	97.00%	97.00%	96.10%

This study has proved to show similar results as previous studies done on the efficacy of USG.

4) Fine Needle Aspiration Cytology

Table 32 : Comparison of sensitivity, specificity, PPV, NPV and accuracy of FNAC between various previous studies and present study 8

Study	Sensitivity	Specificity	PPV	NPV
Mohammed et al	90.62%	100%	100%	95.08%
Kim et al	94.59%	87.91%	79.54%	97.03%
Panjvani et al	97.82%	100%	100%	97.85%
Takhellambham et al	90.48%	100%	100%	95.24%
Present study	100%	97.70%	97.20%	100%

Conclusion

Triple assessment is an important diagnostic tool for appropriate diagnosis of a breast lump. Whenever a patient presented with a breast lump, which is most common pathology, diagnosis can be arrived by means of clinical breast examination by skilful hands, radiologically and pathologically (FNAC). Radiological help is definitively needed for the differentiation between benign and malignant lumps.

As per obtained results in our study, with the diagnostic accuracy is of ultrasonography of 96%, it not only replaces mammography and unnecessary biopsy also decreases the risk factor (number of biopsies) for carcinoma breast. However, as per standard protocol, in discordant cases including suspicious of malignancy biopsy is mandatory.

This study highlights that USG is quite effective in not only diagnosing malignant lump cases but also rules out benign lumps from undergoing further burden.

Summary

As per our study we can conclude that in the triple assessment of the breast lump, ultrasonography is not only helping the diagnosis of malignant neoplasm, but also reduces unnecessary physical, and psychological stress.

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