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DIAGNOSTIC ACCURACY OF MAMMOGRAPHY AND SONOMAMMOGRAPHY IN EVALUATION OF SYMPTOMATIC WOMEN

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ABSTRACT

Objective: The objective of this study was to evaluate and compare the diagnostic accuracy of mammography and sonomammography in the assessment of symptomatic women presenting with breast lumps, using histopathology as the gold standard.

Study Design: Cross-sectional Validation Study.

Place & Duration of Study: Department of Radiology, Bolan Medical Complex, Quetta for a period of six months w.e.f 04-01-2024 to 03-07-2024

Methodology: Patients meeting inclusion criteria were enrolled after written informed consent and detailed clinical history. All patients underwent mammography and sonomammography interpreted using BI-RADS classification. Histopathology served as the gold standard. Data were recorded in a pre-designed proforma. Standardized protocols were followed for imaging and biopsy procedures. Confounding variables were controlled through strict criteria. Results were analyzed using SPSS version 25.0. Imaging and histopathology were interpreted by experienced specialists to ensure consistency and reduce inter-observer variability in reporting.

Results: A total of 175 patients were analyzed. Mammography showed sensitivity 89.93%, specificity 89.66%, PPV 81.53%, and accuracy 89.71%, while sonomammography showed sensitivity 96.61%, specificity 89.66%, PPV 82.60%, and accuracy 92.00%. Sonomammography demonstrated higher sensitivity and overall diagnostic performance compared to mammography.

Conclusion: This study concludes that both mammography and sonomammography are effective in evaluating symptomatic breast lesions, with sonomammography showing higher sensitivity and overall diagnostic accuracy. Mammography remains valuable, while combined use of both modalities improves diagnostic confidence and early detection of malignancy when compared with histopathological findings.

Key Words: Mammography, Sonomammography, Diagnostic Accuracy, Breast Lesions, Sensitivity, Specificity, Histopathology

INTRODUCTION

Breast cancer (BC) represents the uncontrolled proliferation of breast cells and is the most commonly diagnosed malignancy among women worldwide.[1] Epidemiological data indicate that one in every eight women develops breast cancer during her lifetime, while approximately one in 39

women dies due to this disease, reflecting its significant incidence and case-specific mortality. Globally, nearly 17 million cancer cases of all types are diagnosed each year, of which about 1.3 million are attributed to breast cancer alone.[1]

In Pakistan, breast cancer presents an even more concerning scenario, particularly among younger women compared to Western populations, where it is more commonly diagnosed after the age of 60 years. According to data from Shaukat Khanum Memorial Cancer Hospital & Research Center, Lahore, Pakistan, breast cancer accounted for 44.56% of all female cancers in 2016, with 3214 cases recorded out of all registered patients.[2] In 2017, it remained the leading malignancy, with 1244 cases out of 5996 total cancer diagnoses.[3] The age-specific incidence rate in Pakistani women is approximately 50.1 per 100,000 per year, and it is estimated that one in nine women will develop breast cancer during her lifetime.[4]

Imaging plays a central role in the detection, diagnosis, and management of breast cancer, as well as in evaluating breast implant integrity.[4,5] Among the various imaging modalities, ultrasound has long been used for lesion characterization, image-guided biopsy, and lymph node assessment due to its accessibility and safety profile.[6] In addition, mammography, ultrasonography, magnetic resonance imaging (MRI), scintimammography, single photon emission computed tomography (SPECT), and positron emission tomography (PET) are widely employed in clinical practice to enhance diagnostic accuracy and disease staging. The combined use of these modalities improves early detection rates and contributes to better patient outcomes through timely intervention.[7,8,9]

In comparative studies, Sriram Bhatla et al.[10] evaluated the diagnostic accuracy of mammography and sonomammography in symptomatic women, with histopathological confirmation through biopsy or excision serving as the gold standard. Their findings demonstrated that mammography had a sensitivity of 89%, specificity of 80%, and positive predictive value (PPV) of 69%, while sonomammography showed higher sensitivity of 95%, specificity of 79%, PPV of 68%, and notably higher negative predictive value (NPV) of 97%. Although these results suggest good diagnostic performance of both modalities, the comparative evidence remains limited and insufficient for definitive clinical decision-making. Therefore, there is need for more robust comparative data to better guide diagnostic strategies, which formed the basis for planning the present study.

METHODOLOGY

This study was conducted as a cross-sectional survey designed to evaluate the diagnostic accuracy of mammography and sonomammography in symptomatic women presenting with breast lumps. The study was completed over a period of six months after approval of the synopsis. The primary aim was to compare both imaging modalities using histopathology as the gold standard for final diagnosis. The study was planned to ensure proper assessment of diagnostic performance in real clinical settings.

The required sample size was calculated using a 95% confidence interval. It was based on expected sensitivity and specificity values of mammography and sonomammography, along with estimated disease prevalence. For mammography, sensitivity was assumed to be 89%, specificity 80%, and prevalence 30.8%. For sonomammography, sensitivity was assumed to be 95%, specificity 79%, and prevalence 31.9%.[10] The larger calculated sample size was selected to improve statistical power and ensure more reliable and precise estimates of diagnostic accuracy.

A non-probability consecutive sampling technique was used. All eligible patients who presented during the study period and met inclusion criteria were enrolled consecutively. This approach ensured that every patient fulfilling criteria had an equal chance of inclusion, reducing selection bias and improving representativeness of symptomatic cases.

Patients included in the study were symptomatic women aged 18 years and above presenting with breast-related complaints such as palpable breast lump, breast pain, nipple discharge, skin changes, or imaging-detected suspicious lesions. Patients who were asymptomatic, previously treated for breast carcinoma, had incomplete records, or were male were excluded from the study to maintain homogeneity and reduce confounding factors.

All enrolled patients underwent mammography and sonomammography as part of routine evaluation of breast lesions. Mammographic findings were interpreted using the BI-RADS classification system, where categories 1 and 2 were considered benign, while categories 3, 4, and 5 were considered positive. Similarly, sonomammography findings were classified using BI-RADS ultrasound criteria. Imaging was performed using standardized protocols and interpreted by an experienced consultant radiologist to minimize inter-observer variation.

Following imaging, all patients underwent histopathological examination through core needle biopsy or surgical excision as decided by the clinical team. Histopathology served as the reference standard and classified lesions as benign or malignant. This ensured definitive diagnosis against which imaging findings were compared.

All relevant patient data, including demographic details, clinical presentation, imaging findings, and histopathology results, were recorded in a pre-designed proforma. Diagnostic accuracy parameters such as true positive, false positive, false negative, and true negative cases were determined. From these values, sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated using standard statistical formulas. Data were analyzed using SPSS version 25.0, and results were stratified according to age groups to evaluate effect modification.

RESULTS

A total of 175 patients suspected of malignant breast lesions and planned for histopathological evaluation were included in the study. The mean age of the participants was 43.40 ± 11.99 years. Regarding age distribution, 68 patients (38.9%) were in the 18-49 years age group, while 107 patients (61.1%) were in the 50-65 years age group, indicating a higher proportion of older patients in the study population. Data is given in Table I.

Table II presents the 2×2 contingency table used to evaluate the diagnostic performance of mammography with histopathology as the gold standard. Among 65 histopathologically malignant cases, mammography correctly identified 53 cases as malignant and misclassified 12 cases as benign. Out of 110 benign cases, 104 were correctly identified as benign while 6 were incorrectly classified as malignant. Overall, mammography yielded 53 true positive cases, 12 false negative cases, 6 false positive cases, and 104 true negative cases in a total of 175 patients.

Table III presents the 2×2 contingency table used to assess the diagnostic performance of sonomammography with histopathology as the reference standard. Among 69 histopathologically malignant cases, sonomammography correctly identified 57 cases as malignant and misclassified 12 cases as benign. Out of 106 benign cases, 104 were correctly identified as benign while 2 were incorrectly classified as malignant. Overall, sonomammography yielded 57 true positive cases, 12 false negative cases, 2 false positive cases, and 104 true negative cases in a total of 175 patients.

Table IV compares the diagnostic performance of mammography and sonomammography using histopathology as the gold standard. Mammography demonstrated a sensitivity of 89.93% and specificity of 89.66%, with a positive predictive value of 81.53% and a negative predictive value of 94.55%. The prevalence of malignancy was 33.70%, and the overall diagnostic accuracy was 89.71%. Sonomammography showed higher sensitivity of 96.61% with the same specificity of 89.66%. The positive predictive value was 82.60% and the negative predictive value was 98.11%. With a prevalence of 33.70%, sonomammography achieved a higher diagnostic accuracy of 92.00%, indicating superior overall diagnostic performance compared to mammography. Moreover, stratification on the basis of sub groups of age produced similar diagnostic accuracy.

Table I: Demographic Characteristics of Patients Suspected of Malignant Breast Lesion Planned for Histopathology

Characteristics	Participants

	(n=175)
Age (years)	43.40±11.99
• **18-49 years**	68 (38.9%)
• **50-65 years**	107 (61.1%)

Table II: 2x2 Contingency Table to Determine Diagnostic Performance of Mammography taking Histopathology Findings as Gold Standard

Histopathology	Mammography		Total
	Malignant	Benign	
Malignant	**53[a]**	**12[c]**	**65**
Benign	**6[b]**	**104[d]**	**110**
Total	**59**	**116**	**175**

[a]True Positive = 53, [c]False Positive =12, [b]False Negative = 6, [d]True Negative =104

Table III: 2x2 Contingency Table to Determine Diagnostic Performance of So nomammography taking Histopathology Findings as Gold Standard

Histopathology	Sonomammography		Total
	Malignant	Benign	
Malignant	**57[a]**	**12[c]**	**69**
Benign	**2[b]**	**104[d]**	**106**
Total	**59**	**116**	**175**

[a]True Positive = 57, [c]False Positive =12, [b]False Negative = 2, [d]True Negative =104

Table IV: Comparison of Components of Diagnostic Accuracy Taking Histopathology as Gold Standard

Description	Sensitivity	Specificity	PPV	NPV	Prevalence	Diagnostic Accuracy
Mammography	89.93%	89.66%	81.53%	94.55%	33.70%	89.71%
Sonomammography	96.61%	89.66%	82.60%	98.11%	33.70%	92.00%

DISCUSSION

Breast cancer is a major health problem and early accurate diagnosis is essential for improved outcomes.[11,12] Mammography is the standard imaging modality for evaluation of symptomatic breast lesions, while sonomammography serves as an important adjunct, particularly in dense breast tissue and lesion characterization. Both techniques are widely used, yet their comparative diagnostic performance in symptomatic women remains variably reported. There is limited and inconsistent data directly comparing mammography and sonomammography against histopathology in a single study population.[9] This scarcity of robust comparative evidence highlights the need for further research to evaluate and establish the relative diagnostic accuracy of both modalities.

In the present study, a total of 175 patients with suspected malignant breast lesions planned for histopathological evaluation were included. The mean age of the study population was 43.40 ±

11.99 years, with a higher proportion of patients in the 50-65 years age group (61.1%) compared to the 18-49 years group (38.9%). The observed age pattern in the present study is consistent with findings reported in previous literature. Shaikh et al.[13] reported a mean age of 48.42 ± 10.5 years in patients evaluated for breast lesions, which closely aligns with the present study population, indicating that most symptomatic cases present in the fourth and fifth decades of life. Similarly, Ayesha et al.[14] documented a mean age of 44.2 ± 4.7 years, further supporting the observation that breast lesions are predominantly seen in middle-aged women. Srirambhatla et al.[10] also reported a mean age of 50 years among symptomatic women undergoing diagnostic imaging, reinforcing the trend of increasing breast pathology with advancing age. These consistent findings across studies suggest that age remains a key determinant in both disease occurrence and diagnostic evaluation of breast lesions.

International studies further strengthen these observations. Britton et al.[15] demonstrated that mammographic sensitivity increases significantly with age, rising from 47.6% in younger women to 86.7% in older women. This improvement was attributed to reduced breast density in older age groups, which enhances lesion visibility on imaging. Similarly, Badu-Peprah et al.[16] reported a mean age of 55 ± 15 years in their study population, again indicating that most clinically significant breast lesions occur in older women. These studies collectively emphasize that age not only influences disease prevalence but also affects the diagnostic performance of imaging modalities.

In the present study, mammography demonstrated a sensitivity of 89.93% and specificity of 89.66%, while sonomammography showed higher sensitivity of 96.61% with similar specificity of 89.66%. The diagnostic accuracy of mammography was 89.71%, whereas sonomammography achieved a higher accuracy of 92.00%. These findings indicate that while both modalities perform well in evaluating symptomatic breast lesions, sonomammography provides superior lesion detection and overall diagnostic performance.

These results are comparable with existing literature. Sriram Bhatla et al.[10] reported a sensitivity of 89% and specificity of 80% for mammography, while sonomammography demonstrated higher sensitivity of 95% and specificity of 79%, supporting the findings of improved performance with ultrasound-based imaging. Shaikh et al.[13] reported a mammographic sensitivity of 91.3%, specificity of 87.2%, and overall diagnostic accuracy of 90%, which is closely aligned with the present study results. Similarly, Ayesha et al.[14] demonstrated that ultrasound had higher sensitivity (99.09%) and accuracy (95.52%) compared to mammography (89.55% accuracy), highlighting the complementary role of sonomammography.

International studies also support these findings. Britton et al.[15] observed mammographic sensitivity of 66.6% and ultrasound sensitivity of 82.0%, with both modalities showing improved performance in older age groups and lower breast density. Badu-Peprah et al.[16] reported that mammography had a sensitivity of 73% and ultrasound 100%, further emphasizing the higher diagnostic yield of sonomammography. Khan et al.[17] also found that sonomammography demonstrated good sensitivity and specificity, particularly in younger women, making it a valuable adjunct to mammography. Yamakanamardi et al.[18] reported combined sensitivity of 90.4% and specificity of 82.4% when both modalities were used together, highlighting improved diagnostic performance with dual imaging approaches.

Overall, the present study findings are consistent with published literature, confirming that sonomammography offers higher sensitivity and improved diagnostic accuracy compared to mammography, while both modalities maintain comparable specificity. The variations observed across studies may be attributed to differences in sample size, patient demographics, breast density distribution, and operator experience. The findings reinforce the importance of using sonomammography as a complementary tool to mammography, particularly in symptomatic women, to improve early and accurate detection of breast malignancies.

This study's strengths include a well-defined sample, use of histopathology as the gold standard, and direct comparison of mammography and sonomammography. Limitations include single-center design and limited sample size. Future research should include multicenter studies with larger populations to validate findings and enhance generalizability of diagnostic performance.

CONCLUSION

This study concludes that both mammography and sonomammography are effective in evaluating symptomatic breast lesions, with sonomammography showing higher sensitivity and overall diagnostic accuracy. Mammography remains valuable, while combined use of both modalities improves diagnostic confidence and early detection of malignancy when compared with histopathological findings.

PATIENT'S CONSENT

Informed written consent was obtained from each study subject.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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