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Diagnostic Accuracy of Mammography versus Ultrasound and Clinical Examination in the Prediction of Malignancy of Breast in Women Presenting with Palpable Breast Lesions, Taking Histopathology as Gold Standard

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ABSTRACT

Objectives: The purpose of the study is to evaluate the diagnostic accuracy of clinical examination and ultrasound vs mammography in predicting breast cancer in women who report with palpable breast lesions. **Study design:** Cross-sectional (validation) study. **Settings:** Radiology department of Shalamar Hospital, Lahore. **Study design:** March 2025 to May 2025 **Methodology:** The study comprised 130 patients, ages 25 to 70 with breast lumps who were scheduled to have a TruCut core biopsy. Women who were unmarried, had previously received a breast cancer diagnosis, had a recurrence of the disease in the same location, and were receiving chemotherapy or radiation on the same side were not included. The screen film technique and specialized mammography equipment were used to do the mammogram. Typical craniocaudal and mediolateral oblique views of the breast, as well as spot views, when necessary, were part of traditional four-view film mammograms. Knowing the clinical and mammographic results, a bilateral whole-breast ultrasound was conducted. A 7.5-MHZ frequency transducer probe and high resolution diagnostic ultrasonography equipment was used to obtain all sonograms. Mammography, and the presence or absence of malignant breast lesions on ultrasonography plus clinical examination were observed. After that, every patient had a biopsy in the relevant department, and the results were compared to those from mammography and ultrasound. **Results:** Ultrasound and clinical examination sensitivity was (91.03%), specificity (82.69%), PPV (88.75%), NPV (86.0%), and diagnostic accuracy (87.69%) in detecting breast cancer. Mammography sensitivity was (92.11%), specificity (85.19%), PPV (89.76%), NPV (88.46%), and diagnostic accuracy (89.23%) in detecting breast cancer. **Conclusion:** Despite the fact that both mammography and ultrasound were proven to be specific, mammography was thought to have superior sensitivity and diagnostic accuracy.

INTRODUCTION

With over one million new cases reported annually, breast cancer is the most common cancer among women worldwide. It is also the leading cause of death for women, second only to cardiovascular disease. Compared to other Asian countries like India and Iran, Pakistan has a 2.5-fold greater prevalence of breast cancer.[1] Therefore, more research should be done on a palpable breast anomaly. Women frequently bring palpable breast problems to the imaging department. Still unclear, though, is the best sequence and level of imaging needed.[2] The accuracy of the preoperative evaluation's clinical diagnosis, mammography, and breast ultrasonography determines the early detection of breast cancer.[3,4] It is also to allow for exact pre-treatment planning to enable neoadjuvant chemotherapy or a single surgical surgery with distinct surgical margins to minimize the likelihood of tumor recurrence, as patients usually run away after the initial surgical procedure.[5]

In a study[6], 46% of patients had malignant breast tumors identified by USG, while 54% had benign breast lesions. On mammography, however, 53% of individuals had a benign diagnosis and 47% had a cancer. Regarding diagnostic precision, the USG device showed 84.09% specificity, 84.78% NPV, 68.52% PPV, 69.64% sensitivity, and 76% confidence.[6] However, when histopathology was taken into consideration as the gold standard, mammography showed 65% accuracy, 72.34% NPV, 58.49% PPV, 70.45% specificity, and 60.71% sensitivity.[6] In a different study, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of mammography in detecting breast cancer were 77.8%, 97.7%, 87.5%, and

95.6%, respectively.[7] USG has a sensitivity of 55.6%, specificity of 97.7%, PPV of 83.3%, and NPV of 91.5% in detecting breast cancer.[7] According to Wang Y et al. (2008), ultrasonography has a much greater sensitivity for diagnosing breast cancer than mammography (95.7% vs. 78.9%, $p < 0.001$), but a significantly poorer specificity (42.9% vs. 62.3%, $p < 0.001$) than mammography.[8]
The purpose of the study is to evaluate the diagnostic accuracy of clinical examination and ultrasound vs mammography in predicting breast cancer in women who report with palpable breast lesions. When it comes to identifying the kind of breast lumps, mammography is very effective. However, the aforementioned research demonstrated that ultrasound is more accurate than mammography at identifying breast cancer. While mammography is rather expensive and requires expertise, ultrasound is a generally available and inexpensive method for early diagnosis of breast cancer. This study will then validate the most appropriate and effective approach, which might be used locally in the future.

METHODOLOGY

The study was a prospective observational study that was undertaken at the Combined Military Hospital (CMH) Rawalpindi, between January 2021 and June 2023. In the study design, 105 patients diagnosed with lower pole patella fractures received an informed consent form and institutional review board ethical approval to participate in the post-fracture study. Skeletally mature patients aged between 18 and 65 years with isolated, displaced lower pole patella fractures that can be repaired by sutures were included according to the inclusion criteria. The exclusion criteria were patients with mid-pole fractures comminuted type, patients with open injuries, the previous knee surgery, and ligamentous injuries.
All patients underwent operative fixation using the transosseous Krackow suture technique. Under spinal or general anesthesia and following standard aseptic preparation, a midline longitudinal incision was made over the anterior knee to expose the fracture site. The inferior pole fragment was mobilized and debrided of hematoma. Non-absorbable, high-strength sutures (No. 2 FiberWire or equivalent) were passed through the distal patellar tendon using the Krackow technique and then directed transosseously through longitudinal tunnels drilled in the proximal patella fragment. Fracture reduction was confirmed, and the sutures were tensioned and tied securely to achieve anatomical alignment. Postoperative management included early mobilization with a hinged knee brace, and weight-bearing as tolerated based on clinical assessment.
Patients were followed at regular intervals postoperatively—2 weeks, 6 weeks, 3 months, and 6 months—for clinical and radiographic evaluation. Functional outcome was assessed using the Lysholm Knee Scoring Scale and range of motion (ROM) measurements, while complications such as infection, implant irritation, or reoperation were recorded. Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, while categorical data were presented as frequencies and percentages. Paired t-tests and chi-square tests were used to evaluate pre- and post-operative differences, with a p-value of <0.05 considered statistically significant. This descriptive, cross-sectional study was carried out from March 2025 to May 2025 on 130 patients, ages 25 to 70, who had been presenting to the radiology department of Shalamar Hospital in Lahore with breast lumps for more than a month and who were scheduled to have a TruCut core biopsy. With a 95% confidence level and a 12% margin of error, a sample size of 130 cases has been determined. The percentage of breast cancer is 46.0%, and the sensitivity and specificity of USG in detecting breast cancer are 69.64% and 84.09%, respectively.[6] Women who were unmarried, had previously received a breast cancer diagnosis, had a recurrence of the disease in the same location, and were receiving chemotherapy or radiation on the same side were not included.
A total of 130 patients who met the inclusion criteria were chosen following institutional ethical review committee approval. Every patient gave their informed permission. We recorded the following: age, parity, lesion size, duration, and residence. The screen film technique and specialized mammography equipment were used to do the mammogram. Typical craniocaudal and mediolateral oblique views of the breast, as well as spot views, when necessary, were part of traditional four-view film mammograms. Knowing the clinical and mammographic results, a bilateral whole-breast ultrasound was conducted. A 7.5-MHZ frequency transducer probe and high resolution diagnostic ultrasonography equipment was used to obtain all sonograms. Mammography (presence of amorphous calcifications (small and/or hazy such that no clearly defined shape/form can be ascribed), nodules with partially circumscribed and partially indistinct contours, and the presence or absence of malignant breast lesions on ultrasonography plus clinical examination (presence of pain (VAS >3), mass and bloody nipple discharge on clinical examination and spiculations, punctuate calcifications, duct extension, and non-compressibility on ultrasonography) were observed. After that, every patient had a biopsy in the relevant department, and the results—which included mitotic activity, cellular atypia (peomorphism), and an increase (>1:1) in the nuclear cytoplasmic ratio (on microscopy)—were compared to those from mammography and ultrasound. A custom created proforma was used to record all of this information.
Software called SPSS 25.0 was used to evaluate the data that was gathered. The data's normality was examined using the Shapiro-Wilk test. The mean and SD for age, lump duration, and lump size were displayed. Mammography, histology (present or absent), breast cancer on USG and clinical examination, and place of residence (rural versus urban) were displayed as frequency and percentage. We used a 2x2 contingency table to figure out how sensitive, specific, positive predictive value, negative predictive value, and accurate mammography, ultrasound, and clinical examination are at finding breast cancer in women who have palpable breast lesions. Histopathology was used as the gold standard. We utilized stratification to account for things that could change the results, like age, number of children, length of illness, size of lesions, and where people lived. After stratification, a 2x2 contingency

table was used to figure out the diagnostic accuracy. A P-value of less than 0.05 was seen as important.

Breast malignancy on mammography / ultrasound and clinical examination		Breast malignancy on Histopathology	
		Present	Absent
	Present	True positive (a)	False positive (b)
	Absent	False negative (c)	True Negative (d)

The following formula was used to determine diagnostic accuracy:

Sensitivity: The capacity of clinical examinations, mammograms, and ultrasound to accurately diagnose patients with breast cancer.

Specificity: The capacity of clinical examination, mammography, and ultrasound to identify people who do not have breast cancer.

The percentage of patients with breast cancer among all positive cases is known as the positive predictive value.

The percentage of patients that test negative for breast cancer out of all negative instances is known as the negative predictive value.

Patients with breast cancer on ultrasound, clinical examination, mammography, and histology are considered true positives.

Patients with no breast cancer on ultrasound, clinical examination, mammography, or histology are considered true negatives.

Patients who test positive for breast cancer on ultrasound, clinical examination, and mammography but do not test positive on histology are known as false positives.

False negative individuals who show up on histology but do not have breast cancer on ultrasound, clinical examination, or mammography.

RESULTS

The study's age range was 25–70 years old, with a mean age of 50.09 ± 9.18 years. According to Table I, the majority of the patients—79, or 60.77%—were in the 45–70 age range. The illness lasted 6.13 ± 1.44 months on average. Mean size of lesion was 5.32 ± 2.34 cm. Table 1 displays the distribution of patients by different variables. Of the patients who tested positive for breast cancer on ultrasound and clinical examination, 70 (True Positive) had breast cancer, while 08 (False Positive) had no breast cancer according to histopathology. Of the 52 patients who tested negative for ultrasound and clinical examination, 6 (False Negative) had breast cancer on histopathology, but 46 (True Negative) did not (p=0.0001), as Table 2 demonstrates. Ultrasound and clinical examination sensitivity was (91.03%), specificity (82.69%), PPV (88.75%), NPV (86.0%), and diagnostic accuracy (87.69%) in detecting breast cancer. Of the patients who tested positive for breast cancer on mammography, 71 (True Positive) had breast cancer, while 09 (False Positive) had no breast cancer according to histopathology. Of the 51 patients who tested negative for mammography, 07 (False Negative) had breast cancer on histopathology, but 43 (True Negative) did not (p=0.0001), as Table 2 demonstrates. Mammography sensitivity was (92.11%), specificity (85.19%), PPV (89.76%), NPV (88.46%), and diagnostic accuracy (89.23%) in detecting breast cancer. Table 3 displays the diagnostic accuracy of mammography with respect to age, duration of disease, parity, size of lesions and residence. Stratification of diagnostic accuracy of USG and clinical examination with respect to age, duration of disease, parity, size of lesions and residence is shown in Table 4.

Table 1

Distribution of Patients with Other Confounding Variables (N=130)

Confounding variables		Frequency	%age
Age (years)	25-45	51	39.23
	46-70	79	60.77
Duration of disease (months)	≤6	76	58.46
	>6	54	41.54
Parity	≤3	81	62.31
	>3	49	37.69
Size of lesion (cm)	≤5	53	40.77
	>5	77	59.23
Residence	Rural	91	70.0
	Urban	39	30.0

Table 2

Diagnostic Accuracy of Mammography versus Ultrasound and Clinical Examination in the Prediction of Malignancy of Breast in Women Presenting with Palpable Breast Lesions.

	Sensitivity	Specificity	PPV	NPV	DA	
Ultrasound and clinical examination	91.03%	82.69%	88.75%	86.0%	87.69%	0.0001
Mammography	92.11%	85.19%	89.76%	88.46%	89.23%	0.0001

Table 3

Stratification of Diagnostic Accuracy of Mammography with respect to Age, Duration of Disease, Parity, Size of Lesions and Residence.

Variables		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	25-45	91.89%	88.10%	87.18%	92.50%	89.87%	0.001
	46-70	87.50%	90.0%	90.32%	87.10%	88.71%	0.001
Duration (months)	≤6	91.11%	88.10%	89.13%	90.24%	89.66%	0.001
	>6	87.50%	90.0%	87.50%	90.0%	88.89%	0.001
Parity	≤3	92.31%	83.45%	87.65%	88.52%	88.76%	0.001
	>3	90.98%	82.41%	86.49%	87.26%	87.73%	0.001
Size of lesion (cm)	≤5	87.50%	90.0%	87.50%	90.0%	88.89%	0.001
	>5	91.89%	88.10%	87.18%	92.50%	89.87%	0.001
Residence	Rural	90.38%	88.33%	87.04%	91.38%	89.29%	0.001
	Urban	88.24%	91.67%	93.75%	84.62%	89.66%	0.001

Table 4

Stratification of Diagnostic Accuracy of USG and Clinical Examination with respect to Age, Duration of Disease, Parity, Size of Lesions and Residence.

Variables		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	25-45	91.65%	86.35%	87.62%	89.36%	88.65%	0.001
	46-70	90.98%	87.45%	86.79%	88.64%	89.35%	0.001
Duration (months)	≤6	92.35%	86.48%	87.56%	87.98%	89.36%	0.001
	>6	91.25%	87.63%	88.37%	86.45%	88.67%	0.001
Parity	≤3	91.11%	88.10%	89.13%	90.24%	89.66%	0.001
	>3	92.16%	87.85%	88.67%	87.37%	88.47%	0.001
Size of lesion(cm)	≤5	90.35%	86.62%	88.38%	86.47%	87.49%	0.001
	>5	92.43%	87.65%	87.95%	86.87%	88.37%	0.001
Residence	Rural	91.43%	88.46%	86.84%	87.83%	88.39%	0.001
	Urban	91.87%	87.39%	87.49%	88.25%	87.39%	0.001

DISCUSSION

According to the study's findings, mammography and ultrasonography were both safe, accurate, and effective in diagnosing lesions and maintaining the health of the mother, fetus, newborn, and infant. Despite the fact that both screening methods showed 100% PPV and 100% specificity, mammography's sensitivity was greater than ultrasonography's (92.11% vs. 91.03%). Additionally, it was discovered that mammography had a larger negative predictive value than ultrasonography (88.46% vs. 86.0%). In our investigation, we observed that mammography had a greater diagnostic accuracy than ultrasonography (89.23% vs. 87.69%).

Pregnant women with high-risk characteristics for breast cancer were shown to have moderate sensitivity and low risk of prenatal radiation exposure in a meta-analysis evaluating the risk-benefit ratio of mammography. According to the study's findings, mammograms might only be taken into consideration in high-risk situations following a comprehensive risk assessment and collaborative decision-making.[9] According to a different retrospective comparison of mammography and ultrasonography in pregnant women, ultrasound was more sensitive (89%) than mammography (72%), detecting breast lesions without exposing the fetus to radiation. According to the study's findings, ultrasonography should be the main imaging technique utilized to check for breast lesions in expectant mothers.[10]

From May 2023 to April 2024, a cross-sectional retrospective study[11] was carried out at the Shahida Islam Medical Complex's radiology department in Lodhran. Out of 242 females, 132 had ultrasounds and 110 had mammograms. Of the 71 ladies with negative mammograms, 24 had benign biopsy results. Ten of the 68 girls who had negative ultrasonography results with just benign lesions had biopsy confirmation. Ultrasonography had 100% specificity, 85.7% sensitivity, 100% positive predictive value, and 25% negative predictive value. Mammograms had 100% specificity, 92.3% sensitivity, 100% positive predictive value, and 42.8% negative predictive value ($p<0.001$).[11]

In a study[6], 46% of patients had malignant breast tumors identified by USG, while 54% had benign breast lesions. On mammography, however, 53% of individuals had a benign diagnosis and 47% had a cancer. Regarding diagnostic precision, the USG device showed 84.09% specificity, 84.78% NPV, 68.52% PPV, 69.64% sensitivity, and 76% confidence.[6] However, when histopathology was taken into consideration as the gold standard, mammography showed 65% accuracy, 72.34% NPV, 58.49% PPV, 70.45% specificity, and 60.71% sensitivity.[6] In a different study, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of mammography in detecting breast cancer were 77.8%, 97.7%, 87.5%, and 95.6%, respectively.[7] USG has a sensitivity of 55.6%, specificity of 97.7%, PPV of 83.3%, and NPV of 91.5% in detecting breast cancer.[7] According to Wang Y et al. (2008), ultrasonography has a much greater sensitivity for diagnosing breast cancer than mammography (95.7% vs. 78.9%, $p < 0.001$), but a significantly poorer specificity (42.9% vs. 62.3%, $p < 0.001$) than mammography.[8]

Although the study only included lactating women and excluded those who were currently pregnant, it found that contrast-enhanced MRI was safe to perform during lactation and even improved the diagnostic accuracy of breast cancer screening.[12] According to the literature, there are benefits and drawbacks to using mammography or ultrasound for screening pregnant and lactating women. For example, ultrasound was thought to be safe, accurate, adaptable, and easily accessible, but it also has limited sensitivity, requires an operator, and occasionally yields inconclusive results.[13,14]

However, mammography has well-established, standardized protocols, is extremely sensitive, can detect even microcalcifications, and works in tandem with ultrasound.[15] However, a significant disadvantage of mammography was the possibility of prenatal radiation exposure, which was exacerbated by the breast's diminished sensitivity during pregnancy and lactation and occasionally uncomfortable due to the need for manual compressions.[16] In conclusion, both mammography and ultrasound can be used to screen for breast cancer in pregnant and breastfeeding women, but how they are used should depend on the risk factors and unique circumstances of each patient. Mammography may be taken into consideration in certain situations where it can offer more diagnostic information without posing an unreasonable risk to the fetus, however ultrasound was typically chosen because of its safety and adaptability. To make sure that screening methods provide equal weight to safety and efficacy, patients and healthcare professionals had to collaborate on decision-making.[17-19]

Furthermore, the safety and diagnostic precision of breast cancer screening in this population may be further enhanced by further research and technical developments. There were certain limitations to this study, even though it evaluated two screening methods for pregnant and nursing women. Selection bias may have resulted from the study's cross-sectional design and patient selection criteria. Furthermore, because of the small sample size and the fact that this study was single-centered, it is impossible to make genuine generalizations about the broader population. To generalize the results presented in this study, more extensive research was needed.

CONCLUSION

Despite the fact that both mammography and ultrasound were proven to be specific, mammography was thought to have superior sensitivity and diagnostic accuracy. The results presented in this study would benefit from additional research.

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