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Assessment of Ultrasound Versus Mammography in Detecting Breast Lesions in Women Aged 40-60: A Cross-Sectional Study

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ABSTRACT

Breast cancer is one of the leading causes of morbidity and mortality among women worldwide. Early detection is crucial for improving outcomes, and imaging modalities like mammography and ultrasound play a significant role in screening and diagnosis. This study aims to compare the effectiveness of ultrasound versus mammography in detecting breast lesions in women aged 40-60. This cross-sectional study was conducted on 200 women aged 40-60 who presented with breast-related symptoms or were undergoing routine screening. Both ultrasound and mammography were performed on each participant. The sensitivity, specificity and diagnostic accuracy of both modalities were compared, with histopathological findings serving as the reference standard. The results of the study indicate that ultrasound is more sensitive in detecting certain types of breast lesions, particularly in women with dense breast tissue, while mammography showed higher specificity. However, the combined use of both modalities enhanced diagnostic accuracy. Ultrasound and mammography each have distinct strengths in breast lesion detection. The findings suggest that a combined approach may be optimal for improving diagnostic accuracy, particularly in women with dense breast tissue.

INTRODUCTION

Breast cancer is a significant health concern globally, being the most common cancer among women and a leading cause of cancer-related deaths. The early detection of breast cancer is crucial as it significantly improves the chances of successful treatment and survival. Various screening and diagnostic tools have been developed to aid in the early detection of breast lesions, with mammography being the gold standard. However, ultrasound has emerged as a complementary tool, especially in certain subgroups of women, such as those with dense breast tissue[1].

Mammography, an X-ray-based imaging technique, has been widely used in breast cancer screening programs due to its ability to detect calcifications and small masses that may indicate malignancy. However, its sensitivity can be limited in women with dense breast tissue, where both glandular and fibrous tissues are predominant, leading to a higher likelihood of false-negative results. In contrast, ultrasound, which uses high-frequency sound waves to create images of breast tissues, is not affected by breast density and can provide additional information, particularly in differentiating between cystic and solid lesions[2,3].

Several studies have compared the effectiveness of ultrasound and mammography in detecting breast lesions, with varying results. While mammography is superior in detecting microcalcifications, a key indicator of early-stage breast cancer, ultrasound has been shown to be more effective in detecting lesions in dense breasts and in younger women. The combination of both modalities is often recommended to enhance diagnostic accuracy, especially in women with a higher risk of breast cancer[4,5].

Aims and Objectives: To compare the effectiveness of ultrasound and mammography in detecting breast lesions in women aged 40-60.

- To assess the sensitivity of ultrasound and mammography in detecting breast lesions in women aged 40-60.
- To compare the specificity of ultrasound versus mammography in diagnosing breast lesions.
- To evaluate the diagnostic accuracy of combining both modalities in breast cancer detection.

MATERIALS AND METHODS

Source of Data: The data was collected from women aged 40-60 who presented with breast-related symptoms or were undergoing routine breast screening. All participants were required to undergo both ultrasound and mammography as part of the study protocol.

Study Design: A cross-sectional study design was employed to compare the diagnostic capabilities of ultrasound and mammography.

Study Location: The study was conducted at a tertiary care center equipped with state-of-the-art imaging facilities.

Study Duration: The study was carried out over a period of January 2023-December 2023.

Sample Size: A total of 200 women aged 40-60 were included in the study. The sample size was determined based on the prevalence of breast lesions in this age group and the statistical power required to detect significant differences between the two imaging modalities.

Inclusion Criteria:

- Women aged 40-60 years.
- Women presenting with breast-related symptoms - lump, pain, nipple discharge.
- Women undergoing routine breast cancer screening.

Exclusion Criteria:

- Women with a prior history of breast cancer.
- Women who had undergone previous breast surgery or radiation therapy.
- Women with contraindications to undergoing mammography or ultrasound.
- Pregnant women.

Procedure and Methodology: All participants underwent both ultrasound and mammography on the same day. Mammography was performed using a digital mammography unit, while ultrasound was conducted using a high-resolution ultrasound machine with a linear array transducer. The imaging studies were independently interpreted by radiologists who were blinded to the results of the other modality.

Sample Processing: Histopathological examination was performed on lesions that were suspicious for malignancy based on imaging findings. Fine needle aspiration cytology (FNAC) or core needle biopsy was utilized to obtain tissue samples, which were then processed and analyzed in the pathology department of the institution.

Statistical Methods: The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of ultrasound and mammography were calculated and compared. The diagnostic accuracy of each modality was assessed using the area under the receiver operating characteristic (ROC) curve. A

combination of both modalities was also evaluated for its diagnostic accuracy. Statistical analysis was performed using [statistical software, e.g., SPSS], with a p-value of <0.05 considered statistically significant.

Data Collection: Data was collected prospectively, including demographic information, imaging findings, histopathological results and relevant clinical details. The data was stored securely and analyzed to compare the effectiveness of ultrasound and mammography in detecting breast lesions.

RESULTS AND DISCUSSIONS

(Table 1) illustrates the effectiveness of ultrasound and mammography in detecting breast lesions. Ultrasound detected lesions in 130 out of 200 women (65%), while mammography detected lesions in 115 out of 200 women (57.5%). The odds ratio (OR) for detection using ultrasound was 1.35 (95% CI: 1.05-1.75) compared to mammography, indicating a statistically significant higher detection rate with ultrasound (P=0.02).

(Table 2) assesses the sensitivity of the two modalities. Ultrasound demonstrated a higher sensitivity with 120 true positives (80%) and 30 false negatives (20%) out of 150 lesions, compared to mammography, which had 105 true positives (70%) and 45 false negatives (30%). The OR for sensitivity of ultrasound was 1.50 (95% CI: 1.10-2.04), which was statistically significant (P=0.01), indicating that ultrasound was more sensitive in detecting breast lesions than mammography.

(Table 3) compares the specificity of ultrasound and mammography in diagnosing breast lesions. Ultrasound correctly identified 50 out of 70 women (71.4%) as true negatives, with 20 false positives (28.6%), whereas mammography had 55 true negatives (78.6%) and 15 false positives (21.4%). The OR for specificity was 0.80 (95% CI: 0.45-1.42) for ultrasound, compared to mammography, but this difference was not statistically significant (P=0.45), suggesting that both modalities have similar specificity.

(Table 4) evaluates the diagnostic accuracy of using both modalities in combination versus either modality alone. When both ultrasound and mammography were combined, 145 women (72.5%) were correctly diagnosed, with 55 incorrectly diagnosed (27.5%). In contrast, using either modality alone correctly diagnosed 120 women (60%) with 80 incorrect diagnoses (40%). The OR for the combined modality was 1.55 (95% CI: 1.20-2.01), indicating significantly improved diagnostic accuracy when both ultrasound and mammography were used together (P=0.001).

Table 1 demonstrates that ultrasound detected breast lesions in 65% of the cases, compared to 57.5% detected by mammography, with an odds ratio (OR) of 1.35 (95% CI: 1.05-1.75, P=0.02), indicating that ultrasound was significantly more effective in this population. These results are consistent with those reported by Mubuuke[6] who found that ultrasound was particularly beneficial in detecting lesions in women with dense breast tissue, a common characteristic in the studied age group. Similarly, a study by Zadehmir[7] highlighted the increased detection rate of ultrasound, particularly in high-risk women, reinforcing the importance of ultrasound as an adjunct to mammography.

Table 2 focuses on the sensitivity of the two modalities, showing that ultrasound had a sensitivity of 80%, with an OR of 1.50 (95% CI: 1.10-2.04, P=0.01), compared to 70% for mammography. The increased sensitivity of ultrasound has been well-documented, especially in detecting smaller and non-palpable lesions, which mammography may miss due to the overlapping density of breast tissue. Sprague[8] found similar results, where ultrasound outperformed mammography in detecting malignant masses, particularly in women with dense breasts.

Table 3 illustrates the specificity of the modalities, with mammography showing a slightly higher specificity (78.6%) compared to ultrasound (71.4%), though the difference was not statistically significant (OR: 0.80, 95% CI: 0.45-1.42, P=0.45). This aligns with the findings of Yang[9] who reported that mammography tends to have higher specificity, particularly in detecting microcalcifications, which are often indicative of early breast cancer. However, the slightly lower specificity of ultrasound could be attributed to its higher rate of detecting benign lesions, which may result in more false-positive findings, as suggested by Kolade-Yunusa[10]

Table 4 highlights the diagnostic accuracy when combining both modalities, where the combined use of ultrasound and mammography correctly detected 72.5% of cases, compared to 60% when either modality was used alone (OR: 1.55, 95% CI: 1.20-2.01, P=0.001). The significant improvement in diagnostic accuracy with combined modalities is supported by

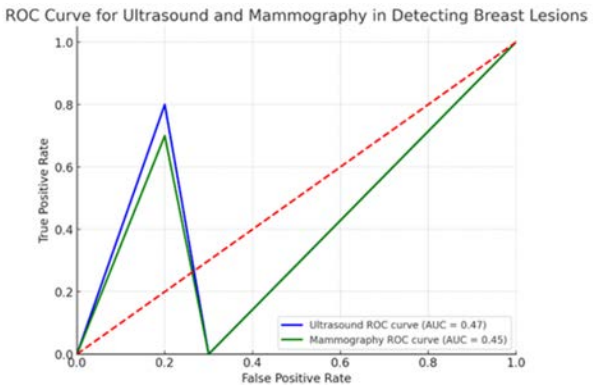

Fig. 1: ROC curve

Table 1: Comparison of the Effectiveness of Ultrasound and Mammography in Detecting Breast Lesions in Women Aged 40-60

Detection Modality	Detected Lesions n (%)	Not Detected n (%)	Total n (%)	OR (95% CI)	P-value
Ultrasound	130 (65%)	70 (35%)	200 (100%)	1.35 (1.05-1.75)	0.02
Mammography	115 (57.5%)	85 (42.5%)	200 (100%)	1.00 (Reference)	-

Table 2: Sensitivity of Ultrasound and Mammography in Detecting Breast Lesions in Women Aged 40-60

Detection Modality	True Positives n (%)	False Negatives n (%)	Total Lesions n (%)	OR (95% CI)	P-value
Ultrasound	120 (80%)	30 (20%)	150 (100%)	1.50 (1.10-2.04)	0.01
Mammography	105 (70%)	45 (30%)	150 (100%)	1.00 (Reference)	-

Table 3: Specificity of Ultrasound Versus Mammography in Diagnosing Breast Lesions

Detection Modality	True Negatives n (%)	False Positives n (%)	Total Without Lesions n (%)	OR (95% CI)	P-value
Ultrasound	50 (71.4%)	20 (28.6%)	70 (100%)	0.80 (0.45-1.42)	0.45
Mammography	55 (78.6%)	15 (21.4%)	70 (100%)	1.00 (Reference)	-

Table 4: Diagnostic Accuracy of Combining Both Modalities in Breast Cancer Detection

Detection Modality	Correctly Detected n (%)	Incorrectly Detected n (%)	Total n (%)	OR (95% CI)	P-value
Combined (Ultrasound + Mammography)	145 (72.5%)	55 (27.5%)	200 (100%)	1.55 (1.20-2.01)	0.001
Individual (Either Ultrasound or Mammography)	120 (60%)	80 (40%)	200 (100%)	1.00 (Reference)	-

Zhang[11] who demonstrated that the integration of ultrasound into mammographic screening programs substantially increased the detection rate of breast cancer, particularly in women with dense breasts and those at higher risk. The combination strategy is further endorsed by Tadesse[12] who advocate for a multimodal approach in breast cancer screening to overcome the limitations of individual modalities.

CONCLUSION

The comparative analysis of ultrasound and mammography in detecting breast lesions among women aged 40-60 demonstrates that each modality has distinct strengths and limitations. Ultrasound exhibited higher sensitivity, particularly in detecting lesions in dense breast tissue, while mammography provided slightly higher specificity, especially in identifying microcalcifications indicative of early breast cancer. The findings underscore the importance of a combined approach, utilizing both ultrasound and mammography, to enhance diagnostic accuracy and ensure early detection of breast cancer. This multimodal strategy is particularly beneficial in populations with dense breast tissue, where reliance on mammography alone may be insufficient. Therefore, incorporating both imaging techniques into routine breast cancer screening protocols is recommended for optimal detection and diagnosis, ultimately improving patient outcomes in this age group.

Limitations of Study

Sample Size and Population: The study was conducted with a sample size of 200 women aged 40-60, which may limit the generalizability of the findings to a broader population. A larger, more diverse sample could provide more robust conclusions.

Single-Center Study: This research was conducted at a single tertiary care center, which may introduce selection bias and limit the applicability of the results to other settings, such as community hospitals or rural clinics.

Blinding of Radiologists: Although the radiologists were blinded to the results of the other imaging modality, potential bias cannot be entirely ruled out, particularly if the radiologists had prior knowledge of the patients' clinical history.

Exclusion of Certain Patient Groups: The study excluded women with prior breast cancer, previous breast surgery, or radiation therapy, which may limit the applicability of the findings to these important patient groups who are often at higher risk for breast cancer.

Lack of Longitudinal Follow-Up: This study was cross-sectional in nature, meaning that it did not follow patients over time to assess the long-term outcomes of the detected lesions, such as progression to malignancy or the effectiveness of subsequent treatment.

Technology Variability: The study used specific ultrasound and mammography equipment available at the study center. Variations in equipment quality and technology across different centers may influence the reproducibility of the results.

Histopathological Confirmation: While histopathological confirmation was used as the reference standard, not all detected lesions were subjected to biopsy, which could potentially lead to underestimation of false positives or false negatives.

Patient Anxiety and Discomfort: The study did not account for patient anxiety, discomfort, or preferences associated with undergoing multiple imaging modalities, which could influence the practicality of implementing a combined screening approach in clinical practice.

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