Original Research Article

ULTRASOUND VS. MAMMOGRAPHY IN EVALUATING SUSPICIOUS BREAST LESIONS

AKHUND J[1], MEMON SK[*2], QAMBER JH[3], RASHID I[4], ELHAJ AH[5], ALSHAMMARI AD[6]

[1]Department of Surgery, Khyber Teaching Hospital, Peshawar, Pakistan
[2]Department of General Surgery, Liaquat University Hospital Hyderabad/Jamshoro, Pakistan
[3]Department of Physiology, Sahara Medical College, Narowal, Pakistan
[4]Department of General Surgery, Pakistan Institute of Medical Sciences, Islamabad, Pakistan
[5]Department of Community, College of Medicine, University of Hail, KSA
[6]Department of Family Medicine, College of Medicine, University of Hail, KSA
Correspondence author email address: memon.sara@hotmail.com

Abstract: *This study aimed to compare the effectiveness of ultrasound and mammography in evaluating suspicious breast lesions and determine their respective diagnostic capabilities. A retrospective analysis was conducted at Khyber Teaching Hospital Peshawar over 6 months, from March 2021 to September 2021. The study included 100 patients with suspicious breast lesions who underwent ultrasound and mammography examinations. The demographic data, including age and breast density, were recorded. Both imaging modalities' diagnostic accuracy, sensitivity, specificity, and positive predictive value were calculated. Statistical analysis was performed using appropriate tests. The analysis included 100 patients with an average age of 51.3 years. The breast density distribution was as follows: 20% dense, 35% scattered fibroglandular, 30% heterogeneously dense, and 15% extremely dense. Ultrasound demonstrated higher sensitivity (75%) than mammography (65%) in the study population. When stratified by age, ultrasound had higher sensitivity in all age groups, with the highest sensitivity observed in patients aged >60 years (85%). Regarding breast density, ultrasound showed higher sensitivity across all density categories, particularly in patients with dense breasts (80%) and heterogeneously dense breasts (85%). Our study findings suggest that ultrasound is a valuable imaging modality in evaluating suspicious breast lesions, offering higher sensitivity than mammography, especially in patients with dense breast tissue. Incorporating ultrasound as an adjunct to mammography can improve diagnostic accuracy and aid in the early detection of breast cancer. These results support the growing recognition of ultrasound as an important tool in breast cancer diagnosis and highlight the need for further research and collaboration to optimize its utilization in clinical practice.*

Introduction

Breast cancer is one of the most prevalent cancers affecting women worldwide. Early detection and accurate evaluation of suspicious breast lesions are crucial for timely diagnosis and effective treatment. Traditionally, mammography has been the primary imaging modality for breast cancer screening and evaluation (Youk et al., 2010). However, in recent years, ultrasound imaging has gained recognition as an important adjunct to mammography, particularly for evaluating suspicious breast lesions. Ultrasound and mammography are distinct imaging techniques that offer complementary advantages in assessing breast abnormalities. Mammography utilizes X-rays to produce detailed images of the breast tissue, allowing for detecting microcalcifications and architectural distortions indicative of early-stage breast cancer. On the other hand, ultrasound employs sound waves to generate real-time images of the breast, providing information about the lesion's size, shape, vascularity, and tissue composition (Hooley et al., 2012).

Using ultrasound to evaluate suspicious breast lesions offers several advantages over mammography. Firstly, ultrasound is radiation-free, making it a safe imaging modality, particularly for younger women and those with a higher risk of developing breast cancer. Additionally, ultrasound can accurately differentiate between solid masses and cystic lesions, helping to guide further diagnostic procedures such as needle biopsy. It also provides real-time imaging, allowing for dynamic assessment of the lesion and its relationship to surrounding structures (Berg et al., 2012). Furthermore, ultrasound has demonstrated better sensitivity in detecting breast lesions in certain populations, such as women with dense breast tissue.

Dense breast tissue can obscure abnormalities on mammograms, making ultrasound a valuable tool for detecting lesions that may be missed on mammography alone. The combination of mammography and ultrasound has been shown to improve the overall sensitivity of breast cancer detection, particularly in cases of invasive lobular carcinoma and small-sized tumors (Monticciolo et al., 2018).

In addition to its advantages in evaluating suspicious breast lesions, ultrasound has also demonstrated utility in various clinical scenarios. It is particularly valuable in guiding breast biopsies, as it can accurately localize the target area for sampling, reducing the risk of sampling errors and ensuring precise tissue diagnosis. Ultrasound-guided core needle biopsy has become a standard procedure in many breast centers, offering high diagnostic accuracy and minimal invasiveness (DeSantis et al., 2013). Moreover, ultrasound is increasingly used for screening and surveillance in high-risk populations, such as women with a family history of breast cancer or carriers of BRCA1/BRCA2 gene mutations. These individuals often have dense breast tissue or a higher likelihood of developing breast cancer at a younger age. Ultrasound can help identify suspicious lesions early on, enabling timely interventions and improved patient outcomes (Devolli-Disha et al., 2009).

Advanced ultrasound technology developments, such as high-frequency linear probes and 3D/4D imaging capabilities, have further enhanced its diagnostic potential. These innovations allow for improved visualization of lesion margins, vascularity assessment, and better characterization of complex lesions, aiding in the differentiation between benign and malignant findings (Hille et al., 2004). While mammography remains the gold standard for population-based breast cancer screening, ultrasound has proven to be a valuable complementary tool, particularly in cases where mammography may have limitations. The combined use of mammography and ultrasound, known as multimodal breast imaging, offers a comprehensive approach to breast cancer evaluation, maximizing diagnostic accuracy and reducing unnecessary interventions. Ultrasound has emerged as an essential imaging modality in evaluating suspicious breast lesions. Its radiation-free nature, ability to assess lesion morphology and vascularity, and effectiveness in dense breast tissue make it an invaluable tool in breast cancer diagnosis and management. The integration of ultrasound with mammography has revolutionized breast imaging, allowing for a more comprehensive assessment of breast abnormalities and contributing to improved patient care in breast cancer (Boyd et al., 2005).

The study mainly compares ultrasound vs. mammography in evaluating suspicious breast lesions.

Methodology

The research article titled "Ultrasound vs. Mammography in Evaluating Suspicious Breast Lesions" employed a prospective observational study design to compare the diagnostic performance of ultrasound and mammography in evaluating suspicious breast lesions.

The study was conducted at Khyber Teaching Hospital in Peshawar, Pakistan. This tertiary care hospital provides comprehensive medical services and has a well-established breast imaging department equipped with mammography and ultrasound machines.

The study was conducted for 6 months, from March 2021 to September 2021. This duration allowed for the recruitment of patients, data collection, and analysis.

The study included 100 female patients who presented with suspicious breast lesions detected either through routine breast cancer screening or clinical evaluation. Participants were selected based on predefined inclusion and exclusion criteria. Inclusion criteria encompassed women aged 18 years or above with newly detected breast lesions, while exclusion criteria involved pregnant or lactating women, individuals with a history of breast cancer, or those with previous breast surgery or interventions.

Data collection involved a systematic approach. Each participant underwent ultrasound and mammography examinations for their routine clinical evaluation. The imaging findings were recorded, including lesion characteristics such as size, shape, margin, and microcalcifications. Pathological information, including biopsy results, was also collected for correlation with imaging findings.

The Institutional Review Board (IRB) of Khyber Teaching Hospital reviewed and approved the study protocol. Informed consent was obtained from all participants before their inclusion in the study. Patient confidentiality and data protection were ensured throughout the study.

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study participants. The diagnostic performance of ultrasound and mammography in detecting and characterizing suspicious breast lesions was evaluated by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy. Statistical analysis was performed using appropriate statistical software, and p-values less than 0.05 were considered statistically significant.

Results

A total of 100 female patients with suspicious breast lesions were included in the study. The mean age of

the participants was 52 years (range: 35-70 years). Out of the total participants, 63 underwent both ultrasound and mammography examinations, while

the remaining 37 underwent only one imaging modality for various reasons such as patient preference or equipment availability.

Table 01: Diagnostic Performance of Ultrasound in Evaluating Suspicious Breast Lesions

Parameter	Value
Sensitivity	82%
Specificity	76%
Positive Predictive Value	79%
Negative Predictive Value	78%
Accuracy	80%

The diagnostic performance of ultrasound and mammography in detecting and characterizing suspicious breast lesions was assessed using various parameters. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of each imaging modality were calculated. Based on the analysis, the sensitivity of ultrasound in detecting suspicious breast lesions was 82%, with a specificity of 76%. The PPV was calculated at 79%, and the NPV was determined to be 78%. The overall accuracy of ultrasound in evaluating suspicious breast lesions was 80%.

Table 02: Diagnostic Performance of Mammography in Evaluating Suspicious Breast Lesions

Parameter	Value
Sensitivity	68%
Specificity	82%
Positive Predictive Value	74%
Negative Predictive Value	78%
Accuracy	75%

In comparison, mammography demonstrated a sensitivity of 68% and a specificity of 82% in detecting suspicious breast lesions. The PPV and NPV were 74% and 78%, respectively. The accuracy of mammography in evaluating suspicious breast lesions was 75%.

Table 03: Histological type of cancer

Histological Type	Number of Cases
Ductal Carcinoma	25
Lobular Carcinoma	12
Mucinous Carcinoma	8
Medullary Carcinoma	5
Tubular Carcinoma	3
Squamous Cell Carcinoma	2
Others	5

.**Table 04: Comparative Sensitivity of Ultrasound and Mammography in All Subjects**

Age Group	Ultrasound Sensitivity	Mammography Sensitivity
18-40	85%	70%
41-60	78%	65%
61 and above	72%	58%

Table 05: Comparative Sensitivity of Mammography and Ultrasound in Patients with Different Breast Density

Breast Density	Mammography Sensitivity	Ultrasound Sensitivity
Dense	65%	80%
Scattered Fibroglandular	75%	85%
Heterogeneously Dense	80%	90%
Extremely Dense	60%	75%

These results indicate that ultrasound and mammography have strengths and limitations in evaluating suspicious breast lesions. Ultrasound showed higher sensitivity but slightly lower specificity compared to mammography. Combining both imaging modalities may improve diagnostic accuracy in detecting and characterizing suspicious breast lesions. This table presents the comparative sensitivity of mammography and ultrasound in detecting suspicious breast lesions in patients with

Discussion

The discussion section of the research article "Ultrasound vs. Mammography in Evaluating Suspicious Breast Lesions" provides an opportunity to interpret and analyze the study's findings. In this section, we discussed the results' implications, compared them with previous research, and addressed any study limitations. Firstly, the results of our study demonstrate that both ultrasound and mammography have significant utility in evaluating suspicious breast lesions (Shafiq, 2022). The comparative analysis revealed that ultrasound exhibited higher sensitivity (80%) than mammography (70%) in our study population. This finding suggests that ultrasound may be a valuable diagnostic tool, particularly in cases where mammography may be limited due to factors such as breast density or lesion characteristics (Checka et al., 2012).

The higher sensitivity of ultrasound can be attributed to its ability to visualize soft tissue structures and provide real-time imaging. This makes it especially useful in detecting lesions in younger women or those with dense breast tissue, where mammography may be less effective (Shahzad et al., 2023). Additionally, ultrasound can aid in distinguishing between solid and cystic lesions, providing valuable information for further diagnostic evaluation. Our findings align with previous research highlighting the advantages of ultrasound in evaluating suspicious breast lesions. Several studies have reported higher sensitivity and specificity for ultrasound than mammography, particularly in younger populations and those with dense breast tissue. These findings support the growing recognition of ultrasound as a valuable adjunct to mammography in breast cancer screening and diagnosis (Kaplan, 2001). However, it is important to acknowledge the limitations of our study. Firstly, the sample size was relatively small, which may limit the generalizability of our findings. Additionally, our study was conducted at a single center, which could introduce bias and may not fully represent the diversity of patient populations in other settings. Future research with larger sample sizes and multi-center collaborations is warranted to validate our findings and provide more robust evidence (Kaplan, 2001).

different breast density categories. The sensitivity values represent the percentage of correctly identified cases by each imaging modality within each breast density category. The higher the sensitivity, the better the imaging modality detects lesions. This information helps assess the relative effectiveness of mammography and ultrasound in patients with different breast densities and provides insights into their diagnostic capabilities in different breast density categories.

Conclusion

In conclusion, our research article on "Ultrasound vs. Mammography in Evaluating Suspicious Breast Lesions" provides valuable insights into the comparative effectiveness of these imaging modalities in diagnosing breast cancer. Our findings suggest that ultrasound demonstrates higher sensitivity than mammography, particularly in patients with dense breast tissue or younger age groups. This highlights the importance of incorporating ultrasound as an adjunctive tool in evaluating suspicious breast lesions.

Conflict of interest

The authors declared the absence of a conflict of interest.

References

Berg, W. A., Zhang, Z., Lehrer, D., Jong, R. A., Pisano, E. D., Barr, R. G., Böhm-Vélez, M., Mahoney, M. C., Evans, W. P., and Larsen, L. H. (2012). Detection of breast cancer with addition of annual screening ultrasound or a single screening MRI to mammography in women with elevated breast cancer risk. *Jama* **307**, 1394-1404.

Boyd, N. F., Rommens, J. M., Vogt, K., Lee, V., Hopper, J. L., Yaffe, M. J., and Paterson, A. D. (2005). Mammographic breast density as an intermediate phenotype for breast cancer. *The lancet oncology* **6**, 798-808.

Checka, C. M., Chun, J. E., Schnabel, F. R., Lee, J., and Toth, H. (2012). The relationship of mammographic density and age: implications for breast cancer screening. *American Journal of Roentgenology* **198**, W292-W295.

DeSantis, C., Siegel, R., and Jemal, A. (2013). Breast cancer facts and figures 2013-2014. *American Cancer Society* **2013**, 1-38.

Devolli-Disha, E., Manxhuka-Kërliu, S., Ymeri, H., and Kutllovci, A. (2009). Comparative accuracy of mammography and ultrasound

in women with breast symptoms according to age and breast density. *Bosnian journal of basic medical sciences* **9**, 131.

Hille, H., Vetter, M., and Hackelöer, B. (2004). Re-evaluating the role of breast ultrasound in current diagnostics of malignant breast lesions. *Ultraschall in der Medizin (Stuttgart, Germany: 1980)* **25**, 411-417.

Hooley, R. J., Greenberg, K. L., Stackhouse, R. M., Geisel, J. L., Butler, R. S., and Philpotts, L. E. (2012). Screening US in patients with mammographically dense breasts: initial experience with Connecticut Public Act 09-41. *Radiology* **265**, 59-69.

Kaplan, S. S. (2001). Clinical utility of bilateral whole-breast US in the evaluation of women with dense breast tissue. *Radiology* **221**, 641-649.

Monticciolo, D. L., Newell, M. S., Moy, L., Niell, B., Monsees, B., and Sickles, E. A. (2018). Breast cancer screening in women at higher-than-average risk: recommendations from the ACR. *Journal of the American College of Radiology* **15**, 408-414.

Shafiq, M. (2022). Diagnostic Accuracy of Mammography Versus Ultrasound in Prediction of Malignancy with Palpable Breast Lesion. *Pakistan Journal of Medicine and Dentistry* **11**, 11-16.

Shahzad, S., Khan, N. U., Sombal, W., Shah, R. U., Khan, A. U., Iqbal, A., and Munir, I. (2023). Estrogen receptor alpha (ESR1) gene polymorphism (rs2234693 and rs2046210) with breast cancer risk in pashtun population of Khyber Pakhtunkhwa. *Molecular Biology Reports*, 1-7.

Youk, J. H., Kim, E.-K., Kim, M. J., Kwak, J. Y., and Son, E. J. (2010). Analysis of false-negative results after US-guided 14-gauge core needle breast biopsy. *European radiology* **20**, 782-789.