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Original Research Article

Comparative Study of MR Mammography and Sonomammography in Characterization of Breast Masses and its Histopathological Correlation

Vinayak Gautam[1], Shambhavi[2]

[1]Professor and Head of Department, Department of Radio-diagnosis, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar

[2]Assistant Professor, Department of Radio-diagnosis, RDJM, Turki, Muzaffarpur, Bihar

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Corresponding author: Dr. Shambhavi

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Abstract:

Background: The most frequent type of cancer among women is breast cancer. Indian women are more likely to have breast cancer than cervical cancer. For early care and the decrease of mortality and morbidity, early diagnosis and characterization of breast masses are crucial. The study major goal was to define breast masses using high resolution ultrasound and magnetic resonance imaging, and then to contrast the results with those of histopathology.

Methods: Women with breast masses participated in this cross-sectional study from February 2022 to January 2023 at the Department of Radio-diagnosis, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar. The women got mammograms, breast ultrasounds, and needle biopsies for histological examination. The BI-RADS characterisation criteria were also considered for evaluating the breast lesions.

Results: 106 breast masses in total were assessed and included in the analysis. 50 percent (53) of them were benign and 53 percent (53) were malignant. Separately, mammography and ultrasound had sensitivity levels of 68.5% and 72.5 percent, respectively. The combined sensitivity of mammography and ultrasonography was 85%. The BI-RADS 5 category had the highest sensitivity, at 59.9%, while the BI-RADS 3 and 5 categories had the highest specificity, at 100%. The BI-RADS 5 category had the highest accuracy, at 79.9%.

Conclusion: The results of this study show that combining ultrasound and mammography could increase the sensitivity and diagnostic precision compared to using these imaging modalities separately. Additionally, to standardize breast imaging reporting, the BI-RADS reporting categorization, which has an ideal positive predictive value, should be encouraged.

Keywords: Breast Cancer, MR Mammography, Sonomammography, Benign, Malignant, BI-RADD.

Introduction

In the world, breast cancer is one of the leading causes of death for middle-aged women. Indian women are more likely to have breast cancer than cervical cancer. Breast cancer is becoming more prevalent worldwide, both in industrialized and developing nations. Although breast cancer can be found in its earlier stages, instances are typically discovered much later because of ignorance. The method of breast cancer detection and screening has previously been the X-ray mammography. It is a tool for initial detection, and one of its strongest features is its capacity to pick up minor micro calcification. However, it does have certain drawbacks, such as the radiation issue, which is bad for young women because they have dense breast tissue, etc. As innovative techniques for diagnosing breast cancer, MRI and ultrasound have recently gained popularity. Ultrasound plays a fundamental role in separating cystic masses from solid masses. It also has the benefit of being real-time, making any action simple. Greater sensitivity in the identification, diagnosis, and staging of occult breast cancer in the contralateral breast has been demonstrated using MRI. Ultrasound has the drawback of being user-dependent and not being suitable for post-menopausal involuted breasts. MRI raises the burden of follow-up care while having low specificity. The gold standard for a conclusive diagnosis of breast cancer is a histopathological analysis.

Material and Methods

At Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, 106 adult women with breast masses who had been referred for a core needle biopsy (CNB) between February 2022 and January 2023 participated in this cross-sectional study. Following breast sonography, the women who were chosen through sequential sampling had mammography. A mass was deemed suspect for malignancy based on the results of the breast ultrasound if it exhibited any of the following characteristics: uneven and angular margins, posterior shadowing, micro-lobulations, hypoechoic, micro-calcifications, and some flow on color Doppler ultrasound.

The tumor was classified as suggestive of malignancy on mammography due to the following characteristics: hyperdense, micro-lobulated, had micro calcifications, irregular, and spiculated. Each woman's BI-RADS scores for sonography and mammography were determined. The highest BI-RADS categorization was then taken into consideration for more research. The following BI-RADS categorization was taken into consideration:

- BI-RADS 3 (probably benign): ≤ 2% malignancy risk
- BI-RADS 4A (low suspicion): >2% to ≤10% malignancy risk
- BI-RADS 4B (moderate suspicion): >10% to ≤50% malignancy risk
- BI-RADS 4C (high suspicion): > 50% to < 95% malignancy risk
- BI-RADS 5 (probably malignant): ≥ 95% malignancy risk

A radiologist used an ultrasound transducer with a high frequency transducer of 8–12 MHz to guide the core needle biopsy (CNB). 5–10 biopsies were obtained and stored in formalin in preparation for a lab-based histological investigation. Histological reports and the surgeon's judgment guided the procedure. The pathology of the removed masses was further examined.

The STATA 13.0 statistical tool was used for analysis after the data were entered into an Epidata database. When a breast mass was determined to be malignant by imaging and histology, it was classified as a True Positive (TP) in the BI-RADS 3 category, and when it was determined to be benign by imaging and histology, it was classified as a True Negative (TN). False Positive (FP) and False Negative (FN) diagnoses were proposed when imaging indicated a cancer but histology did not, and when imaging indicated a benign lesion but histology indicated a malignancy, respectively.

When imaging and pathology for BI-RADS 4A, 4B, 4C, and 5 indicated that a mass was malignant, this was regarded as a True Positive (TP), and when both indicated that the mass was benign, this was regarded as a True Negative (TN). False Positive (FP) refers to situations where imaging indicates a mass is cancerous but histology indicates it is not. When imaging revealed a benign mass but histology revealed cancer, a false negative (FN) was recorded.

Positive predictive value (PPV) was calculated as the proportion of TP: TP+FP, while negative predictive value (NPV) was calculated as the proportion of TN: TN+FN. Sensitivity were calculated as the proportion of TP: TP+FN. According to the percentage of TP+TN: all women, accuracy were calculated. The ability of mammography, sonography, and mammography and sonography combined to predict malignancy was evaluated using receiver operator characteristic (ROC) and area under the curve (AUC).

Results

During the study period, 106 women with breast masses were assessed. At the time of the evaluation, each of these contained a single mass. 106 breast masses were therefore assessed. It was 46.9 years on average. Tables 1 and 2 show how well sonography and mammography perform in terms of making diagnoses when compared to biopsy data, which served as the study's gold standard. According to the results of the CNB histology, 53 (50%) of the masses were benign and 53 (50%) were malignant.

Table 1: Accuracy of sonography, mammography and sonography plus mammography for malignancy

Imaging	Sensitivity (%, 95%CI)	Specificity (%, 95%CI)	PPV (%, 95%CI)	NPV (%, 95%CI)	Accuracy (%, 95%CI)
Mammography	72.5 (63.1-80.8)	43.7 (34.1-53.7)	56.1 (51-60.9)	62.1 (52.8-70.2)	49.9 (51.1-65.1)
Ultrasound	68.5 (58.8-78.1)	48.4 (38.6-58.1)	56.6 (51.4-61.8)	61 (52.5-68.7)	57.8 (51.6-64.9)
Mammography +Ultrasound	85 (76.4-91.4)	42.5 (33.2-53.1)	60.1 (55.5-64.4)	74.1 (64.1-83.2)	64.2 (57-1-70.5)

The most important finding from table 1 is that the combined sensitivity of mammography and ultrasound was much higher than the sensitivity of each imaging modality used alone.

However, when compared to the independent individual specificities of either ultrasound alone or mammography alone, the specificity of ultrasound and mammography combined was considerably diminished. When ROC analysis was used to predict breast cancer, mammography and ultrasonography together had a predictive capacity (AUC=0.637) that was superior to both mammography alone (AUC=0.581) and ultrasound alone (AUC=0.585).

The evaluated masses were divided into 14 BI-RADS 3 masses, 49 BI-RADS 4A masses, 2 BI-RADS 4B masses, 9 BI-RADS 4C masses, and 32 BI-RADS 5 masses.

Table 2: Accuracy of BI-RADS characterization for benign and malignant masses

BI-RADS Category	Sensitivity (%, 95%CI)	Specificity (%, 95%CI)	PPV (%, 95%CI)	NPV (%, 95%CI)	Accuracy (%, 95%CI)
3	25.6 (18.2-34.8)	100 (96.5-100)	100	57.1 (54.3-59.9)	63.1 (56-69.2)
4A	22.3 (14.9-32)	22.7 (21.1-39.2)	24.1 (17.8-32.1)	27.9 (21.9-34.6)	25.8 (21.1-33.1)
4B	2.7 (0.5-7.9)	99.3 (95.1-100)	75.2 (24-96.5)	50.5 (50.1-52.1)	51.1 (44.1-57.9)
4C	13.9 (7.9-21.8)	98.1 (92-99.3)	82.8 (60.1-94.3)	53.2 (51-54.8)	56.1 (48.7-62.5)
5	59.9 (50.3-70.1)	100 (97-100)	100	72.1 (67.1-76.1)	79.9 (74.1-84.8)

The sensitivity, specificity, PPV, NPV, and accuracy for each particular BI-RADS categorization are listed in Table 2. The category with the highest sensitivity was BI-RADS 5, while the categories with the best specificity were BI-RADS 3 and 5. Those classified as BI-RADS 5 showed the highest accuracy.

Discussion

The aim of this study was to compare the diagnostic accuracy of breast ultrasound and mammography in women with breast masses and to assess the diagnostic validity of BI-RADS breast mass characterisation in these women. Mammography and ultrasound demonstrated similar sensitivity in detecting breast cancer. When compared to mammography, breast ultrasound demonstrated a greater level of specificity. When ultrasound and mammography were utilized in conjunction, as opposed to when each imaging modality was used separately, the sensitivity and ultimately diagnostic accuracy greatly improved. These results are consistent with other earlier research that found that ultrasonography and mammography together have a greater combined sensitivity and accuracy when assessing breast masses for cancer. [1-3] As a result, it suggests that using both ultrasonography and mammography as diagnostic methods is preferable to using just one of them when analysing breast lumps to rule out malignancy.

However, the reduced specificity of these two together suggests that they might not completely rule out breast cancer, which has also been previously documented. This decreased specificity when ultrasound and mammography were combined may be caused by the fact that ultrasonography is able to detect some lesions in the breast that mammography is still unable to detect, especially in women with very dense breasts. There is a paucity of published literature reporting findings on the relative accuracy of breast ultrasound and mammography combined from low-resource settings, where breast densities of women may differ from those in high income settings, despite the fact that such studies have been reported in the more developed settings. Thus, the study's findings offer empirical data from a context with limited resources. Choosing the best approach for screening is now the difficult decision. The current imaging guidelines promote mammography screening as the imaging gold standard, especially for women over 40. Mammography does have some restrictions, though. For instance, women with thick breasts had a considerably lower sensitivity, although having a higher risk of breast cancer. [4,5] This is true despite the fact that automatic reporting technologies exist, such as computer-assisted systems, which can perform better than a human reader even with dense breasts during mammography. [6,7] From the findings of this study, it could be argued that adding ultrasound to the screening procedures of breast cancer is more likely to improve detection and aid early patient management. Previous literature has backed this observation. [8] In low-income areas without access to mammography equipment or standardized nationwide mammography screening programs for all women, the use of breast ultrasonography becomes even more crucial. The significant costs associated with establishing routine mammography screening techniques are one of the causes of this. Thus, given that breast ultrasound is more easily available and more economical in low-income settings, it might be pushed as an evaluation tool. The low PPV and presumably high NPV of ultrasonography as a complement to mammography in breast cancer screening continue to be a topic of discussion. Thus, more research in many contexts is required to add to these discussions.

It has been suggested in many circumstances that breast masses be described using the BI-RADS reporting system since it may help distinguish between benign and malignant breast masses. The BI-RADS system's accuracy rates are still up for debate, and more study in a variety of contexts is required to provide evidence of the system's potential accuracy. The results of this study demonstrate high PPV rates for BI-RADS 3-5. According to an observation that has been made and alluded to in earlier publications, employing BI-RADS may be able to distinguish between benign and malignant tumors and decrease the need for unneeded procedures as well as biopsies. [9] The malignancy risk of BI-RADS 3 is less than 2% and most clinicians would just recommend follow up in this category of patients. Breast masses under BI-RADS 4 are not classically malignant, but are suspicious enough for core needle biopsy while BI-RADS 5 masses have higher risk of malignancy and should thus undergo biopsy. [10,11]

Other factors affect the accuracy of imaging when it comes to suspected breast lesions. Examples include the patient's age, surgical background, lesion features, menstrual and menopausal status, imaging procedures and protocols, imaging equipment used, including the utilization of cutting-edge methods like vacuum-assisted breast biopsy technology, and many more.

All of these should be taken into account when utilizing imaging accuracy results. Breast density was not taken into account in the analysis, which is a major flaw in this study and could have a significant impact. Future research on this topic should take breast density into consideration. We also did not conduct an age-related sub-analysis to compare results between women under the age of 40 and those over this age range, thus we advise future research to examine this issue. In order to add to the body of knowledge supporting the use of breast ultrasonography and BI-RADS accuracy in various situations, additional studies on these topics are also requested.

Conclusion

The results of this study show that combining ultrasound and mammography improves the sensitivity and specificity of breast cancer diagnosis as compared to using each imaging modality alone. Additionally, the BI-RADS classification of breast masses had the highest positive predictive value, suggesting that this uniform reporting on breast masses could be useful in identifying women who urgently require biopsies and additional histological examination. In low resource situations where a significant number of women with breast masses could not easily get mammography, the use of ultrasound should be encouraged as an additional layer of investigation.

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