Original Article

Histopathological Correlation of Breast Carcinoma with Breast Imaging-Reporting and Data System (BI-RADS) in Tertiary Care Hospital of Eastern India

Dr. Sweta Kumari, Dr. Anita Kumari*, Dr. Krishna Pratap
Department of Radiotherapy, Comprehensive Cancer Care Clinic, NMCH, Patna, India.
***Corresponding author's E-mail:** kr.dranita@gmail.com

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ABSTRACT

Introduction: Early diagnosis and prompt therapy are the most effective interventions for management of breast cancer. The cost of therapy of breast cancer rises with a more advanced stage of the disease at the diagnosis. The two inexpensive, easily available, non-invasive radiological procedures mammography and ultrasonography are useful in early detection and perform a significant part in diagnosis, treatment, and prognosis and enhance chances of survival in breast cancer patients. To remove heterogenicity in assessment of certain finding in imaging, a globally recognisable evaluation system must be established.

Aims/ objective: To evaluate the accuracy, sensitivity, specificity, and predictive value of the BI-RADS categorisation and correlate it with histopathological diagnosis.

Materials and Method: 203 patients were enrolled at our centre and their demographic details, clinical history, radiological and histopathological reports were collected. The chosen participants were divided into BI-RADS categories from 3 to 5. The most probable benign BI-RADS category was 3, and the most probable malignant BI-RADS categories were 4 or 5. Sensitivity, specificity, and predictive values of BI-RADS categorisation were calculated with respect to final diagnosis with histopathology.

Results: Histopathologically 12% of patients in BI-RADS category 3 were diagnosed with malignant neoplasm whereas 5.77% patients in BI-RADS category 5 were diagnosed with benign lesion. Positive predictive value and specificity of BI-RADS category 5 to detect malignancy was found to be 94.23% and 93.62% respectively which reduced to 43.14% and 64.42% when taking BI-RADS 4 and 5 together. Also, most of the post-menopausal women presented with malignant neoplasm (67.31%) while 66.67% of the pre-menopausal women presented with benign neoplasm.

Conclusion: BI-RADS assessment of mammography and ultrasonography proved to have effective sensitivity and predictive values in detection of malignancy. For a complete picture in the early identification of breast cancer, assessment of radiographic findings with the BI-RADS categorization should be utilised along with clinical evaluation and histopathology.

Keywords: Breast Cancer, BI-RADS, Radiography, Mammography, Histopathology, Malignancy.

INTRODUCTION

The most frequent carcinoma in women is breast carcinoma, according to statistics globally.[1] The incidence of breast cancer is on the rise, according to a number of reports from several cancer surveillance programmes in India that have been released.[2] Although a great deal of breast cancers (around 80%) are classified as Infiltrating Duct Carcinoma, without being otherwise specified, the way they behave varies. [3]

A variety of malignant epithelial neoplasms with glandular origins in the breast make up invasive breast cancer. In India, the overall incidence rate has risen over the past few years, perhaps as a result of improved rates of diagnosis brought on by efficient screening. But among females, breast carcinoma continues to be a significant cause of morbidity and death due to cancer.

According to Globocan data for 2020, breast carcinoma caused 10.6 percent of all fatalities and 13.5 percent of all cases of carcinoma in India, with a composite mortality rate of 2.81. [4]

According to a report, the 5-year overall survival rate was 95 percent for patients in stage 1, 92 percent for patients in stage 2, 70% for patients in stage 3, and just 21% for patients in stage 4.[5] In India, patients with carcinoma of the breast had a worse chance of surviving as compared to Western nations because of early age of onset, advanced illness at diagnosis, delayed initiation of decisive treatment plan, and insufficient or inconsistent management.[6] Early diagnosis and prompt therapy are the most effective interventions for management of breast cancer, in accordance with the World Cancer Report 2020.[7] The cost of therapy of breast cancer rises with a more advanced stage of the disease at the diagnosis, according to a 2018 systematic review of 20 researches. As a result, early detection of breast cancer can result in less expensive treatment.[8]

The most typical manifestation of benign or malignant breast tumours is a breast lump. Thanks to modern imaging investigations, diagnosis of lesions in the breast has significantly improved in recent decades. The two inexpensive, easily available, non-invasive radiological procedures that are useful in detection and perform a significant part in early diagnosis, treatment, and positive prognosis and enhance breast cancer chances of survival are the mammography and ultrasonography. [9] To remove

heterogenicity in assessment of certain finding in imaging, a globally recognisable evaluation system must be established.

The BI-RADS (Breast-Imaging and Reporting Data System) has become commonly utilised for reporting in breast ultrasonography and mammogram. Giving a BI-RADS category score and appropriately advising additional treatment plans is how the reporting takes place.

The likelihood of malignant neoplasm is lowest in BI-RADS group 3 (less than 2%). Breast carcinoma is predicted by BI-RADS category 4 at a rate of over 30%, while malignancy is predicted by BI-RADS category 5 at a rate of over 95%. To categorise the likelihood of malignancy, the BI-RADS category 4 is broken down into BI-RADS 4a, 4b, and 4c sub-categories. The American College of Radiology (ACR) suggests a distinct course of treatment plan according to the category provided.[10] A recommended annual mammography screening regimen is for BI-RADS categories 1 and 2. For BI-RADS category 3, a short period of follow-up over a six-month period is advised, while tissue biopsy is advised for BI-RADS categories 4 and 5.

There are few studies analysing effectiveness of our diagnostics in India, despite the fact that the BI-RADS category has been applied in the reporting of ultrasonography and mammography in healthcare facilities nationally. In the present study, we assessed the radiological evaluation findings from tertiary care hospital of eastern India and compared them to the final diagnosis established by histopathology. We further evaluated the accuracy, sensitivity, and specificity, of our diagnosis. The overall goal of this research was to show the BI-RADS categories' high predictive value and assess their influence on treatment plan.

MATERIALS AND METHODS

This was a retrospective and observational study conducted NMCH, Patna from January 2018 to December 2022 after taking approval of Institutional Ethics Committee. The study was started after providing and explaining participant information sheet and taking written informed consent from study participants as per guidelines of good clinical practice and declaration of Helsinki.

Inclusion Criteria: Female patients of age 18 to 70 years undergoing radiological examination through ultrasonography or mammography, patients undergoing histopathological test of biopsy from their breast lesion for confirmation of diagnosis of breast carcinoma.

Exclusion Criteria: Patient with inadequate or inconclusive or no radiological or histopathological findings, patients with inadequate clinical records or history, patient in category 0-2 or 6 according to BI-RADS.

The consecutive sampling method was utilised to enrol all the patients meeting our inclusion and exclusion criteria and willing to participate. 203 patients were enrolled and their demographic details, clinical history, radiological and histopathological reports were collected.

The chosen participants were divided into BI-RADS categories from 3 to 5. The most probable benign BI-RADS category was 3, and the most probable malignant BI-RADS categories were 4 or 5.

The BI-RADS for mammography and ultrasonography includes the following categories: [10]

- Category 0 refers to an inadequate evaluation
- Category 1 refers to a negative result
- Category 2 refers to a benign tumour
- Category 3 refers to likely benign tumour
- Category 4 refers to a suspicious neoplasm
- Category 5 refers to report which highly indicative of malignant neoplasm
- Category 6 refers to an established biopsy-proven malignant neoplasm.

The patient's age, history, menopausal status, histological diagnosis, and pathology reports were all reviewed as part of the baseline demographic and clinical characteristics and correlated with BI-RADS category. Either a mastectomy, a large local excision, or a core breast biopsy were used to diagnose the breast lesion.

A set of illnesses collectively known as benign breast lesions include a variety of histological origins, including epithelial, stromal, or other breast tissues. Benign and borderline phyllodes lesions were classed as benign breast lesions in our study.

Statistical Analysis: Data was analysed using SPSS version 24.0 for Windows. Descriptive statistics was used to summarize demographic, clinical, radiological, BI-RADS categorisation and histopathological characteristics. Data will be expressed as frequency and percentage. Frequency of different categories of breast lesions was compared with each other using chi-square test or fisher's exact test (as appropriate) for evaluating statistical significance of difference. Sensitivity, specificity, and predictive values of BI-RADS categorisation were calculated with respect to final diagnosis with histopathology. A p-value of less than 0.05 was taken as measure of statistical significance.

RESULTS

A total of 207 specimens from 203 patients were collected during the study period of 2 years. Bilateral biopsies from breast were taken from 4 patients. Breast lump was commonest presenting complain. Breast pain and discharge from nipple were less reported.

Table 1: Baseline demographic and clinical characteristics of patients with breast tumours (n=203)

Variables		Value (%)
Age in mean ± SD	54.34 ± 10.67	
Menopausal status	Pre- menopausal women	75 (36.95)
	Peri-menopausal women	24 (11.82)
	Post-menopausal women	104 (51.23)
Histopathological Diagnosis	Benign	94 (46.31)
	Malignant	109 (53.69)
BI-RADS Category	3	50 (24.63)
	4	101 (49.75)
	5	52 (25.62)
Type of Biopsy	Core	81 (39.9)
	Excision	122 (60.1)

Most of the patients were post-menopausal of age group 40-60 years. Most of the patients belonged to post-menopausal group (51.23%), were having malignant lesion (53.69%) and were in 4th category of BI-RADS.

Table 2: BI-RADS category of benign and malignant cases

BI-RADS Category	Histopathological Diagnosis		P-Value (Chi-square Test)
	Malignant	Benign	
Category 3, n (%)	6 (12.00)	44 (88.00)	<0.0001
Category 4, n (%)	56 (55.45)	45 (44.55)	
Category 5, n (%)	49 (94.23)	3 (5.77)	

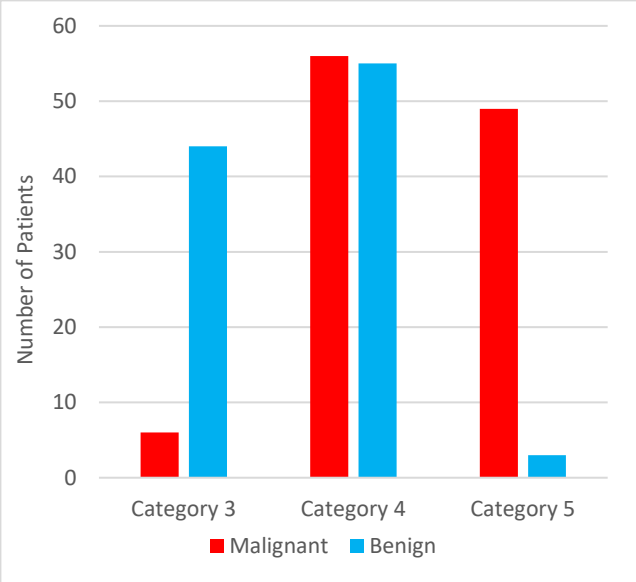

Figure 1: BI-RADS category of benign and malignant cases

Only 12% of patients in BI-RADS category 3 were diagnosed with malignant neoplasm histopathologically whereas only 5.77% patients in BI-RADS category 5 were diagnosed with benign lesion histopathologically. Patients in BI-RADS 4 category were nearly equally distributed according to histopathological benign or malignant diagnosis.

Table 3: Sensitivity, specificity, PPV, and NPV of BI-RADS scoring of diagnosing malignancy

Statistic	Value	95% Confidence Interval
Sensitivity	94.59%	88.61-97.99
Specificity	43.14%	33.37-53.32
Positive Predictive Value (PPV)	64.42%	60.32-68.32
Negative Predictive Value (NPV)	88.00%	76.55-94.28
Accuracy	69.95%	63.31-76.03

With category 4 or 5 denoting malignancy, and 3 denoting benign lesion, BI-RADS was found to have high sensitivity (94.59%) and negative predictive value (88.00%). Positive predictive value and specificity of category 5 BI-RADS to detect malignancy was found to be 94.23% and 93.62% respectively which reduced to 43.14% and 64.42% when taking BI-RADS 4 and 5 together.

Table 4: Menopausal status of benign and malignant cases

BI-RADS Category	Histopathological Diagnosis		P-Value (Chi-square Test)
	Malignant (%) n=109	Benign (%) (n = 94)	
Pre- menopausal women	25 (33.33)	50 (66.67)	<0.0001
Peri-menopausal women	14 (58.33)	10 (41.67)	
Post-menopausal women	70 (67.31)	34 (32.69)	

Most of the post-menopausal women presented with malignant neoplasm (67.31%) whereas most of the pre-menopausal women presented with benign neoplasm (66.67%).

Table 5: Type of malignant breast cancer diagnosed be histopathology

Type	Number of patients	%
Invasive ductal carcinoma	148	72.91
Ductal carcinoma in situ	14	6.90
Invasive lobular carcinoma	12	5.91
Solid papillary carcinoma	5	2.46
Malignant phyllodes tumour	4	1.97
Metaplastic and mucinous carcinoma	4	1.97
Others	16	7.88

Invasive ductal carcinoma was most common form of breast carcinoma (72.91%), followed by ductal carcinoma in situ (6.90%) and invasive lobular carcinoma (5.91%).

DISCUSSION

Before the introduction of the BI-RADS scoring system, doctors were perplexed by the inconsistent nomenclature used during radiographic assessment. These have frequently resulted in misunderstandings and discrepancies for subsequent assessment, which may affect the prognosis and the overall survival rate.[11] The BI-RADS grading system was designed for standardizing radiology findings when examining breast mammography or ultrasonography, primarily for differentiating between benign and potentially malignant lesions and providing care advice.

The malignancy rates, based on BI-RADS, vary from 2% for BI-RADS 3 category lesions to 95 percent for BI-RADS category 5 lesions.[10] A few other studies that are similar to this study have shown that the positive predictive value for BI-RADS category 5 is capable of going as much as 100 percent. In general, sensitivity, specificity, PPV, and NPV were similar in previous research articles. [12-15] In their investigation of 492 patients, Liberman et al. found that the positive predictive value for malignant lesions in BI-RADS category 5 values varied from 81 percent to 97 percent.[12] The positive predictive value for BI-RADS category 4 was less, between 23 percent to 24 percent. According to Chotiyano et al., the positive predictive value for BI-RADS category 5 in 424 women was 85 percent.[16]

This was comparable to the positive predictive value value of 95 percent reported by American Cancer Research along with other studies, as well as a positive predictive value value ranging from 80 percent to 97 percent. In suspicious malignant patients, Siegmann et al. found a correlation between the BI-RADS scoring and histopathological findings. On 132 patients with identified mammography lesions, core biopsies of breast were carried out. From 6.3 percent in the 3rd category to 16.7 percent in 4th BI-RADS category and as much as 85 percent in 5th BI-RADS category, the incidence of malignant neoplasm rose.[17] The substantial link between BI-RADS categorization and histopathological outcomes was also supported by Hoti et al. in their study.[18] A distinction was established for 3rd BI-RADS category, where final diagnosis of 1 patient was ductal carcinoma in situ. A second study comprising 97 individuals suggested that breast lesions in BI-RADS category 3 be monitored and confirmed by histopathology. [18]

Breast ultrasonography has been suggested as an addition to mammogram by both ACR and the Society of Breast Imaging. Yet, not all of the outcomes in our research were confirmed with both scans. The statistically significant P-values for mammography and ultrasonography BI-RADS reporting in differentiating benign from malignant breast lesion were found in prospective research conducted by Harini et al. on 55 participants.[19] Higher sensitivity and specificity for identifying breast malignancy are promised by combining the two techniques. In research of 110 cases, Silva and Furtado found that the ultrasonography characteristics of breast cancer have a strong predictive value, considerably affecting the suggested treatment plan and prognosis. [20]

This study demonstrated that breast cancer was the histological diagnosis for every patient with imaging results indicating a high probability of malignant neoplasm. Most of the mammography and ultrasonography findings that were identified as malignant lesion matched the histological diagnosis of a malignant breast neoplasm, demonstrating that the mammography was the best screening option for detecting breast carcinoma in women older than 40.[21]

The calcification process is a crucial mammogram criterion because of the correlation between its form and location and the histopathology of the tumour. Mammary calcification may occasionally be the first indication that carcinoma of the breast is developing. Microcalcification facilitated the identification of over half of the non-palpable breast cancers.[22] Invasive breast carcinomas are typically linked to microcalcification, according to different research that revealed a greater diagnostic probability for ductal carcinoma in situ according to those lesions.[23] Spiculated edges, an irregular shape, linear microcalcifications, and segmented microcalcifications are characteristics that may be seen and have the strongest PPV.[12] In the current research, coarse calcifications, which sre normally a benign characteristic without any microcalcification seen, was documented in one malignant lesion which was in 3rd BI-RADS category.

In this study, we followed up on patients where histological tests indicated that the tissue was either benign breast lesion or not a good representation of the tumour by repeating the biopsy procedure or by preserving frozen sections during the operation. An additional biopsy is advised if there are any discrepancies between the clinical and radiological findings with a biopsy made totally of normal breast tissue, recommended by the EC Working Group on Breast Screening Pathology.[24] Therefore, accurate lesion localization and obtaining an appropriate tissue specimen may lessen the number of false negative result. Breast biopsies with papillary tumours may be difficult to read and require further immunohistochemical testing for confirming the diagnosis. Considerable false positive and false negative cases are seen while diagnosing papillary tumours, despite of the inclusion of ancillary investigations.[25]

Neoadjuvant chemotherapy was given to a few of the cancer patients before the surgery. Some surgeons recommended patients mastectomy or broad local excision, after which they received systemic therapy.

Two more important variables to take into account in the progression of breast cancer are age and menopausal state. Compared to pre menopausal and peri menopausal women, post menopausal women had considerably higher malignancy rate, according to this study. These findings

confirm earlier research in the Asian people, where the average age at diagnosis was 50.6 years. [26, 27]

CONCLUSION

BI-RADS assessment of mammography and ultrasonography proved to have effective sensitivity and predictive values in detection of malignancy. Overall, most of the patients in category 3 of BI-RADS were diagnosed with benign breast tumour and most of patients in category 5 were diagnosed with malignant breast cancer histopathologically. In the expert care of a skilled radiologist, this method can serve as a very effective predictor of cancer. For a complete picture in the early identification of breast cancer, assessment of radiographic findings with the BI-RADS categorization should be utilised along with clinical evaluation and histopathology.

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