Histopathologic Findings of Breast Lesions and It's Association with Corresponding Radiologic Findings.

*Datta T,[1] Asaduzzaman,[2] Ray TK,[3] Hoque MM[4]

Abstract

Background: Invasive breast carcinoma is one of the most common carcinoma in women. Breast Imaging-Reporting and Data System (BI-RADS) classification besides histopathology has become an important tool for evaluation of malignant breast diseases. The purpose of this study is to assess the similarity between radiological and histopathological findings and illustrate the predictive value in the BI-RADS category.

Methods: This is a retrospective study, done at National Institute of Burn and Plastic Surgery, Dhaka from January 2023 to December 2023, included those patients who had radiological examination with BI-RADS categories 3, 4 and 5 followed by histopathological examination to confirm the diagnosis based on breast core biopsy and excision specimen within 1 year. The clinico-radiologic features were correlated with the histopathologic results using the chi- square test. The scoring system was designed based on the significant predictive features of malignancy, and its diagnostic performance was compared with that of the Breast Imaging-Reporting and Data System (BI-RADS) category.

Result: Among 111 cases, by histopathological diagnosis, malignancy was found in 54 cases (48.6%) and benign was found in 57 cases (51.4%). BI-RADS scoring category 3,4 and 5 cases were 51(45.9%), 26(23.4%) and 34(30.6%) respectively. P-value from Chi-square test shows strong association of malignancy with age ≥50, post-menopause and higher BI-RADS categories like 4 and 5. Overall, the breast lesions evaluated by BI-RADS classification have a sensitivity of 94.48%, specificity of 43.14%, a PPV of 63.9% and a NPV of 88%.

Conclusion: A strong association was found between BI-RADS score 4,5 and histopathologically diagnosed malignant lesion.

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1. **Dr. Tanusree Datta, MBBS, MD (Pathology), Assistant Professor, Pathology Department, National Institute of Burn and Plastic Surgery, Dhaka. tanusreebsmmu89@gmail.com.*
2. *Dr. Asaduzzaman, MBBS, MD (Pathology), Associate Professor, Pathology Department, National Institute of Burn and Plastic Surgery, Dhaka.*
3. *Dr. Major Tapan Kumar Ray, MBBS, FCPS Trainee Officer, Combined Military Hospital, Dhaka.*
4. *Dr. Mohammad Mahabubul Hoque, MBBS, MD (Pathology), M. Med, Associate Professor, Pathology Department, National Institute of Laboratory Medicine and Referral Centre, Dhaka.*

**For correspondence*

Introduction

The fifth most common cause of cancer-related death among women globally is breast cancer.[1] It is the most common form of cancer in Bangladeshi women and is listed as the second leading cause of cancer death among women.[2]

An important component for screening of any breast lesion is the diagnosis of pre-operative pathology. For a histological diagnosis, image-guided percutaneous biopsy of a breast lump is now a dependable substitute for surgical biopsy. Core biopsies are less invasive than surgery, can be completed quickly, leave less scarring, breast deformity and are rarely associated with complications like hematomas and infections. Because fewer surgeries are required, patients who have percutaneous core biopsies have lower diagnostic costs.[3,4,5,6] A more intrusive method of obtaining a breast lesion is excision biopsy.

Although it offers a standardized lexicon for characterizing lesion findings, the Breast Imaging Reporting and Data System (BI-RADS) lexicon lacks clear guidelines for classifying particular imaging aspects into diagnostic categories. The BI-RADS has a moderate level of inter-reader agreement.[7] Mammography and more recently breast ultrasound reporting have made extensive use of the Breast-Imaging and Reporting Data System (BI-RADS).Giving a BI-RADS category score and appropriately suggesting more management is how the report is completed. The following are the specifics of the BI-RADS for ultrasonography: i) incomplete evaluation (category 0); ii) negative (category 1); iii) benign finding or result (category 2); iv) likely benign findings (category 3); v) suspicious abnormality (category 4); vi) highly indicative of malignancy (category 5); and vii) known biopsy-proven cancer (category 6). The possibility of malignancy is the lowest (<2%) for BI-RADS category 3.

BI-RADS category 5 has the highest probability of malignancy at over 95%, while BI-RADS category 4 predicts breast cancer at about 30%. To stratify the possibility to occur malignancy, BI-RADS category 4 is further subdivided into BI-RADS 4a, 4b, and 4c.[8]

It is important to know how histopathologic findings relate to comparable radiologic findings. The aim of this study is to examine the relationship between histopathologic and radiologic findings by examining the histology of a breast lump biopsy material as well as association with clinical and demographic findings.

The agreement between histopathology results and imaging features determines how well breast cancer is diagnosed. Although the Breast Imaging Reporting and Data System (BI-RADS) offers uniform risk stratification, little is known about how it relates to immune-histo-chemical markers and histological grade. The effectiveness as diagnostic tool of the BI-RADS 3, 4, and 5 categories was evaluated in this study.[9] In the current investigation, we compared the final diagnosis made by histopathological examination of breast lesions with the findings of our institution's radiological assessment.

Methods

This single-center retrospective observational study was conducted on breast lesions received for histopathological examination at the histopathology department, National Institute of Burn and Plastic Surgery (NIBPS) from January 2023 to December 2023. Corresponding tissue blocks were collected from the archives of above mentioned laboratory. Tissue blocks were achieved by core-needle biopsy and excision biopsy.

Patient's demographic data and BI-RADS score were collected. Statistical analysis was performed by use of SPSS 26 software program. Result was expressed in number, percentage, descriptive statistics, chi-squared test as the test of significance, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

Ethical Issues

This was a non- commercial, retrospective observational study. No sensitive or identifiable data was collected on the database. This study obtained an ethical clearance certificate from the IRB (Institutional review Board) of NIBPS, Dhaka

Results

From January 2023 to December 2023, a total 111 cases were enrolled in this study (N=111). They were distributed according to age, menopausal status, histopathological diagnosis and BI-RADS scoring.

Table I: Distribution of patients according to age (N=111)

Variables		Years
Age		
	Minimum	19
	Maximum	80
	Mean	41.66

A total of 111 specimens from 111 patients were collected during a 1-year period. The chief presenting complaint was a palpable breast lump. The age of all cases ranged from 19 years old to 80 years old (mean = 41.66 years old).

Table II: Distribution of patients according to menopausal state (N=111)

Menopausal status	n (%)
Pre-menopausal (<40 years)	49 (44.1)
Peri-menopausal (41-49 years)	33 (29.7)
Post-menopausal (≥50 years)	29 (26.1)

Among 111 cases, the age of included patients ranged from 19-80 years. We found 49 (44.1%) cases belong to premenopausal group followed by 33 (29.7%) cases in perimenopausal and 29 (26.1%) cases in postmenopausal women.

Out of these 111 cases, we found 51 (45.9%) cases of category 3, 26 (23.4%) cases of category 4 and 34 (30.6%) cases of category 5 according to BI-RADS scoring system.

Table III: Distribution of patients according to histopathological diagnosis (N=111)

Histopathological diagnosis	n (%)
Ductal carcinoma in situ	5 (4.5)
Fibroadenoma	19 (17.1)
Borderline phyllodes	2 (1.8)
Benign phyllodes	4 (3.6)
Chronic mastitis	3 (2.7)
Fibrocystic disease	18 (16.2)
Intraductal papilloma	2 (1.8)
Malignant phyllodes	1 (0.9)
Usual ductal hyperplasia	3 (2.7)
Granulomatous mastitis	2 (1.8)
Atypical ductal hyperplasia	1 (0.9)
Chronic mastitis with usual ductal hyperplasia	1 (0.9)
Benign breast tissue	1 (0.9)
Myoepithelioma	1 (0.9)
Invsive ductal carcinoma Grade 1	6 (5.4)
Invsive ductal carcinoma Grade 2	39 (35.1)
Invsive ductal carcinoma Grade 3	2 (1.8)
Invasive Lobular carcinoma	1 (0.9)

Table III shows the all histopathological diagnosis of included 111 cases of this study. According to this table, 39 (35.1%) cases were invasive ductal carcinoma grade 2 followed by 19 (17.1%) cases were fibroadenoma and 18 (16.2%) cases were fibrocystic disease.

Table IV: Association of benign and malignant lesions in relation with age, menopausal state and BI-RADS scoring

	Histolopathological category		P – value
	Benign (%)	Malignant (%)	
Age Group			
< 50	53 (47.75)	25 (22.52)	<0.001
≥ 50	4 (3.60)	29 (26.13)	
Total	57 (51.35)	54 (48.65)	
Menopausal state			
Pre-menopausal	33 (29.72)	16 (14.41)	<0.001
Peri-menopausal	20 (18.02)	9 (8.11)	
Post-menopausal	4 (3.60)	29 (26.13)	
Total	57 (51.35)	54 (48.65)	
BI-RADS scoring			
Category 3	46 (41.44)	5 (4.50)	<0.001
Category 4	10 (9.01)	16 (14.42)	
Category 5	1 (0.90)	33 (29.73)	
Total	57 (51.35)	54 (48.65)	

When categorised according to either benign or malignant cases based on histopathological examination, age more than 50 years, post-menopausal women and BI-RADS category 5 were associated with significantly higher malignant cases (P < 0.001).The lesions were examined by histopathological examination and were determined as benign breast lesions in 46 (41.44%) cases that received a BI-RADS category 3 score, 10 (9.01%) cases as BI-RADS category 4 and 1(0.90%) case in BI-RADS category 5. 5 (4.50%) cases were diagnosed as malignant with BI-RADS category 3, 16 (14.42%) cases as BI-RADS category 4 and 33(29.73%) cases with category 5.

Table V: Diagnostic performance and association of BI-RADS with malignancy

Variable	Subcat-egory	Malignant (n)	Benign (n)	Total (n)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P-value
BI-RADS Category	3	5	46	51	9.26	80.70	9.8	90.2	<0.001
	4	16	10	26	29.63	82.46	61.5	69.0	
	5	33	1	34	61.11	98.25	97.1	77.0	
Overall BI-RADS	–	54	57	111	94.48	43.14	63.9	88.0	

According to table V, the PPV for BI-RADS category 5 lesions for malignancy was 97.1% whereas the NPV of BI-RADS category 3 lesions for malignancy was 90.2%. BI-RADS category 5 is linked with a significantly higher frequency of malignant breast cases than BI-RADS category 4 (P <0.001). Overall, the breast lesions evaluated by BI-RADS classification have a sensitivity of 94.48%, specificity of 43.14%, a positive predictive value (PPV) of 63.9% and a negative predictive value (NPV) of 88%.BI-RADS 3 cases are mostly benign having low PPV with high NPV.

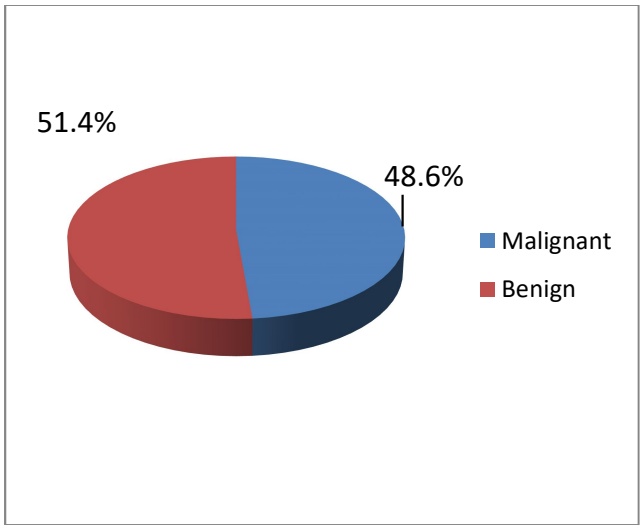

Figure 1. Pie chart showing distribution of patients according to histopathological category (N=111)

Figure 1 shows that 57(51.4%) cases were benign whereas 54 (48.6%) cases were malignant out of total 111 patients.

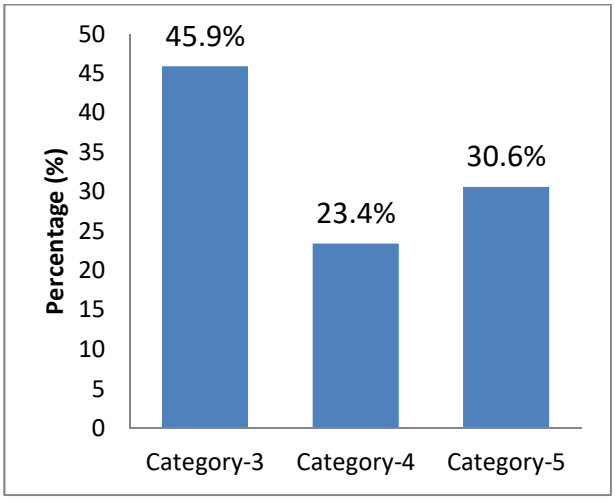

Figure 2. Bar chart showing distribution of patients according to BI-RADS scoring (N=111).

Figure 3. Photomicrograph showing histopathological section of fibroadenoma (H&E stain X 4x)

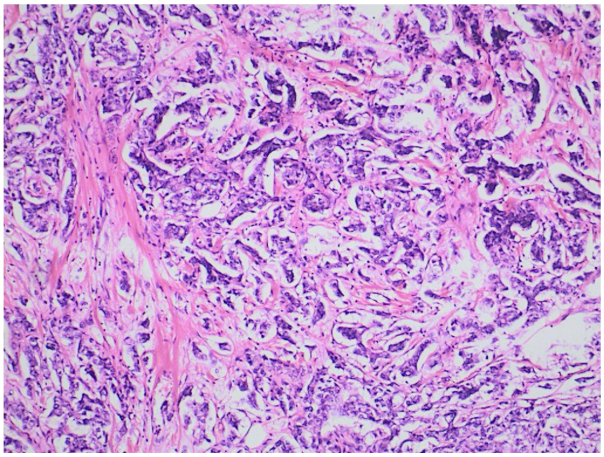

Figure 4. Photomicrograph showing histopathological section of invasive ductal carcinoma, grade-2 (H&E stain X 10x)

Discussion

The chi-square analysis indicated highly significant associations ($p<0.001$ for each factor) between breast lesion outcome (malignant versus benign) and the variables like age group, menopausal status and BI-RADS category. In other words, the differences in cancer rates across these categories are very unlikely to be due to chance. For example, women aged ≥50 had a higher malignancy rate than those of <50 years. Postmenopausal women were far more likely to have cancer than pre- or peri-menopausal women. This strong effect of age is consistent with established epidemiology: breast cancer risk rises with age (most cases occur after age 50)[10]. Likewise, natural menopause increased by lifetime estrogen exposure, effectively doubling breast cancer risk relative to premenopause.[11] Thus, our finding of a high malignancy rate in postmenopausal women aged ≥50 underscores a well-known clinical pattern: older, postmenopausal patients carry much higher background risk.[11] Clinically, this suggests heightened vigilance in older/postmenopausal patients.

Our analysis of BI-RADS categories also revealed a clear trend: higher BI-RADS scores strongly predicted malignancy ($p<0.001$). BI-RADS category 5 was by far the most predictive of cancer, whereas category 3 was rarely malignant. In our study, BI-RADS 3 lesions yielded only 5 cancers out of 51 cases having PPV 9.8% with a sensitivity of 9.26%; reflecting that very few of the total malignancies fell into category 3. By contrast, BI-RADS 5 had 33 cancers out of 34 cases having PPV 97.1% with specificity 98.25%. In BI-RADS 4 we found 16 malignant cases out of 26 cases with PPV 61.5%. These data imply that BI-RADS 3 is essentially a probably benign category having **very low positive predictive value (9.8%)** and **high negative predictive value** (90.2%). Conversely, BI-RADS 5 has high chance of malignancy, as intended by the lexicon – high specificity (98.25%) and high PPV (97.1%) of BI-RADS 5 confirm that nearly all category 5 lesions were cancerous. The moderate values for BI-RADS 4 (sensitivity 29.6%, specificity 82.46%, PPV 61.5%) reflect its role as an intermediate-risk category.

These performance measures align with published reports. For example, Weaver *et al.* found that radiologic findings as BI-RADS 5 had an 84.6% cancer yield, while BI-RADS 4 had 24.6%.[12]Another study similarly reported as PPV of BI-RADS 5 is 93.3% and BI-RADS 4 is 26.2%. Our PPV (97.1%) for BI-RADS 5 is essentially identical to these prior studies.[7]Liberman et al. in their study on 492 patients reported that the PPV for malignant lesions values in BI-RADS category 5 ranged from 81% to 97%.[13]Our higher PPV (61.5%) for BI-RADS 4 likely reflects the case mix: small studies or higher-risk populations can yield a larger fraction of true cancers in category 4. In general, BI-RADS 4 is known to be heterogeneous (often subdivided into 4A/4B/4C with malignancy risk 2–95%), so a moderate PPV around 30–60% is not unexpected.[12]

Critically, the **low sensitivity of BI-RADS 3** in our data means that this category alone would miss most cancers if taken as a negative screen (it captured only 9.8% of the actual malignancies). However, this is by design: BI-RADS 3 is intended for findings that look almost certainly benign (American College of Radiology BI-RADS guidelines aim for <2% malignancy in category 3). The correspondingly **high NPV 90.2%** means that a BI-RADS 3 classification indeed reliably predicts absence of cancer. In practice, this justifies a strategy of short-interval follow-up rather than immediate biopsy for BI-RADS 3 findings. By contrast, moderate sensitivity 29.6% and PPV 61.5% of BI-RADS 4

indicates that it captures a significant but far from complete fraction of malignancies. Most malignancies in our series fell into category 5 or 4, consistent with the intermediate risk of category 4. Clinically this means BI-RADS 4 patients warrant biopsy (since 60% proved malignant) but one should remember that 40% will be benign. BI-RADS 5 has very high specificity and PPV imply it is an excellent "rule-in" test: essentially all BI-RADS 5 cases should be managed as cancer unless proven otherwise.

In summary, our findings reinforce known patterns: **older age and postmenopausal status are strongly associated with breast malignancy** and **higher BI-RADS categories carry dramatically higher cancer risk.** These results are in line with prior literature (e.g. Weaver *et al.* on BI-RADS accuracy) and with screening guidelines (risk rises in women ≥50 years).[7,10,12] The very high cancer rate in postmenopausal women aged ≥50 years is especially clinically relevant. It underscores that a breast lesion in this group, even if only moderately suspicious, should be taken very seriously. The low sensitivity of BI-RADS 3 suggests that maintaining BI-RADS 3 as a probably benign category is appropriate, but also cautions clinicians not to dismiss subtle findings outright. Overall, our data support the existing paradigm that age, menopausal status and BI-RADS scoring are all powerful determinants of malignancy risk.[10]

Conclusion

The efficacy as diagnostic tool of BI-RADS scoring depends on its association with histopathological findings obtained through biopsy samples. A high level of BI-RADS score is usually associated with higher chance of malignancy. Thus correlating BI-RADS findings with corresponding histopathological report may play a vital role in breast cancer diagnosis and proper treatment.

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