



Histopathological Patterns and Diagnostic Outcomes of Cancerous and Non-Cancerous Breast Tumors

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ABSTRACT:

Background: Breast cancer is the most commonly diagnosed malignancy in women worldwide and a leading cause of cancer mortality. In low- and middle-income countries, age distribution, delayed diagnosis and pathological features contribute to distinct clinical patterns. Histopathological evaluation is essential for accurate diagnosis and prognostication. This study aimed to analyze the histopathological patterns of malignant and benign breast tumors and assess the associations between histopathological features and tumor grade.

Methods: This cross-sectional study was conducted at the Department of Surgery, Bangladesh Medical University, Dhaka, from January to December 2025. A total of 300 histopathologically confirmed breast tumors were included. Demographic and clinicopathological data were collected and malignant tumors were graded using standard criteria. The associations between histopathological features and tumor grade were analyzed using SPSS version 25.0.

Results: Among the 300 patients, 125 had malignant and 175 had benign tumors. Malignant tumors were frequent in women aged ≥ 50 years (41.6%), with a mean age of 46.8 ± 13.3 years, whereas benign lesions predominated in those aged < 40 years (70.9%). Right-sided involvement was more common in malignant cases than in benign cases. Intratumoral necrosis ($p=0.02$) and desmoplasia ($p=0.002$) were significantly associated with higher tumor grade. Among benign lesions, chronic breast abscesses (19.4%) and fibrocystic disease (16.0%) were the most frequent.

Conclusion: Breast tumors exhibit marked histopathological diversity, with significant grade-related associations in malignant cases and a spectrum of benign lesions. A detailed pathological evaluation remains fundamental for accurate diagnosis and management.

Introduction

Breast cancer remains the most frequently diagnosed malignancy among women worldwide and represents a leading cause of cancer-related mortality. According to global estimates, breast cancer accounted for over 2.3 million new cases in 2020, with a substantial burden projected to rise further by 2040 [1,2]. Recent analyses indicate persistent increases in incidence across both developed and developing regions, with shifting

demographic patterns and widening disparities in outcomes [3]. The epidemiological landscape is influenced by reproductive factors, lifestyle changes, genetic susceptibility and environmental exposures [4,5].

While the global burden is well documented, variations in age distribution, stage at presentation and tumor characteristics are particularly evident in low- and middle-income countries. Studies have shown that women in resource-limited settings often present at



younger ages and with more advanced disease [6,7]. Socioeconomic determinants, limited screening infrastructure and diagnostic delays contribute significantly to these patterns [8,9]. In Bangladesh, emerging registry data and recent investigations have highlighted growing cancer incidence and notable gaps in early detection and diagnostic pathways [10].

Breast tumors encompass a heterogeneous group of lesions ranging from benign proliferative conditions to invasive carcinomas. Histopathological evaluation remains the gold standard for definitive diagnosis and classification. The World Health Organization classification provides a structured framework for categorizing breast neoplasms based on morphological and molecular features [11]. Accurate pathological assessment is critical not only for diagnosis but also for prognostication and therapeutic decision-making.

Malignant breast tumors demonstrate considerable heterogeneity in histological type, grade and associated features such as lymphocytic infiltration, necrosis, desmoplastic response and lymphovascular invasion, all of which may influence biological behavior and clinical outcomes [12,13]. Tumor grading, in particular, serves as an essential prognostic parameter and guides treatment strategies in conjunction with molecular profiling [14,15]. Understanding the distribution of these histopathological features within specific populations contributes to improved risk stratification and management planning.

Conversely, benign breast lesions are common and constitute a significant proportion of surgical specimens. Conditions such as fibroadenoma, fibrocystic disease and inflammatory processes frequently present as palpable masses, often mimicking malignancy clinically or radiologically [16,17]. Regional audits have demonstrated considerable variation in the spectrum of benign lesions, underscoring the need for local data to inform diagnostic algorithms and patient counseling [18,19].

Despite increasing global evidence, comprehensive data describing the histopathological patterns of both malignant and benign breast tumors in Bangladesh remain limited. Existing studies have largely focused on either malignant profiles or specific subgroups, with relatively few examining the full spectrum of breast lesions within a single institutional framework.

Furthermore, detailed analysis of histopathological features in relation to tumor grade is sparse in this setting.

Given the rising cancer burden and evolving diagnostic capabilities in Bangladesh, a systematic evaluation of histopathological patterns is timely. This study therefore aimed to analyze the distribution of cancerous and non-cancerous breast tumors and to examine the association between selected histopathological features and tumor grade in a tertiary care center.

Materials & Methods

This cross-sectional analytical study was conducted in the Department of Surgery at Bangladesh Medical University (BMU), Dhaka, Bangladesh, from January to December 2025. The study population comprised patients presenting with clinically or radiologically suspected breast masses who subsequently underwent histopathological evaluation. A total of 300 consecutive cases were included, consisting of 125 malignant and 175 benign breast tumors confirmed by histopathology.

Selection Criteria:

Inclusion Criteria

- Patients presenting with a breast lump.
- Patients undergoing surgical excision, core needle biopsy, or lumpectomy with histopathological examination.
- Histologically confirmed benign or malignant breast tumors.

Exclusion Criteria

- Inadequate or inconclusive biopsy specimens.
- Recurrent breast tumors previously treated elsewhere.
- Cases lacking complete clinical or histopathological data.

Data Collection Procedure

Data were collected prospectively using a structured data collection form. After clinical evaluation in the surgical outpatient or inpatient department, patients with breast masses underwent radiological assessment when indicated, including ultrasonography or mammography. Tissue diagnosis was established through core needle biopsy, excisional biopsy, lumpectomy, or mastectomy specimens. All specimens were fixed in 10% neutral buffered formalin, processed routinely and embedded in



paraffin. Sections of 3–5 μm thickness were stained with hematoxylin and eosin for microscopic examination.

Histopathological evaluation was performed by experienced pathologists. Malignant tumors were graded using standard morphological criteria and specific features such as lymphocytic response, intratumoral necrosis, desmoplasia, lymphovascular invasion, perineural invasion, microcalcification and presence of ductal carcinoma in situ (DCIS) components were recorded. Tumor border characteristics were also documented. Benign lesions were categorized based on established histopathological classifications.

Demographic and clinicopathological data, including age and laterality, were recorded systematically. All participants provided informed consent before inclusion. Confidentiality was properly maintained throughout the study.

Statistical Analysis

Data were analyzed using SPSS version 25.0. Descriptive statistics were applied to summarize demographic and clinicopathological variables. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean \pm standard deviation. Associations between histopathological features and tumor grade were assessed using the chi-square test, with $p < 0.05$ considered statistically significant.

Results

A total of 300 breast tumor cases were analyzed, comprising 125 malignant and 175 benign lesions. Malignant tumors were more common in older age groups, whereas benign lesions predominated among younger patients. Laterality showed a slight right-sided predominance in malignant cases. Certain histopathological features, particularly intratumoral necrosis and desmoplasia, demonstrated significant associations with tumor grade. Benign lesions displayed a wide histopathological spectrum, with inflammatory and fibrocystic conditions being most frequent.

Table 1: Age distribution of study population (n=300)

Age (Years)	Malignant (n=125) n (%)	Benign (n=175) n (%)
<40	41 (32.8)	124 (70.9)
40–49	32 (25.6)	32 (18.3)
≥ 50	52 (41.6)	19 (10.9)
Mean \pm SD	46.8 \pm 13.3	35.1 \pm 11.0

Table 1 presents the age distribution of patients according to tumor type. Among malignant cases (n=125), 41.6% were aged ≥ 50 years, 25.6% were 40–49 years and 32.8% were below 40 years. The mean age for malignant tumors was 46.8 \pm 13.3 years. In contrast, benign tumors (n=175) were more frequent in younger women, with 70.9% below 40 years, 18.3% between 40–49 years and 10.9% aged ≥ 50 years. The mean age in the benign group was 35.1 \pm 11.0 years.

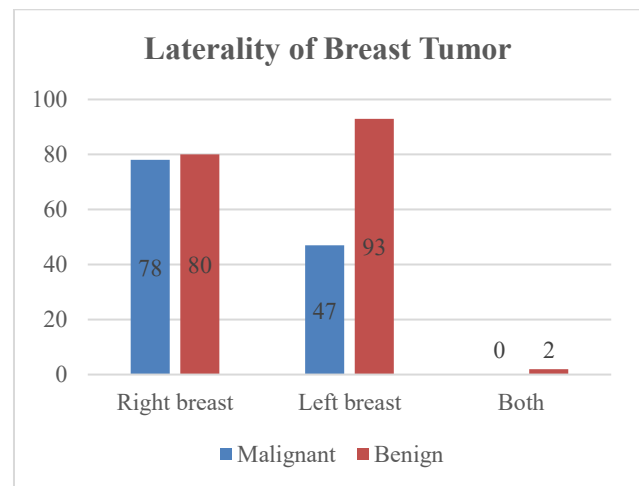


Figure 1: Laterality of Breast Tumors in Malignant and Benign Cases

Figure 1 presents the tumor laterality. Among malignant tumors, 78 cases involved the right breast and 47 the left breast; no bilateral malignant cases were observed. In benign lesions, 80 involved the right breast, 93 the left breast and 2 were bilateral. Overall, unilateral presentation was predominant in both groups.

**Table 2. Association of Histopathological Features with Tumor Grade in Malignant Breast Tumors (n=125).**

Feature	Predominant Category	Frequency (n)	Grade 1 (n=19)	Grade 2 (n=89)	Grade 3 (n=17)	P-value
Lymphocytic response	Mild	109	17 (89.5%)	77 (86.5%)	15 (88.2%)	0.95
	Moderate	16	2 (10.5%)	12 (13.5%)	2 (11.8%)	
Intratumoral necrosis	Present	43	4 (21.1%)	29 (32.6%)	10 (58.8%)	0.02
	Not seen	82	15 (78.9%)	60 (67.4%)	7 (41.2%)	
Microcalcification	Present	10	0 (0.0%)	9 (10.1%)	1 (5.9%)	0.17
	Not seen	115	19 (100.0%)	80 (89.9%)	16 (94.1%)	
Desmoplasia	Mild	49	2 (10.5%)	41 (46.1%)	6 (35.3%)	0.002
	Moderate	76	17 (89.5%)	48 (53.9%)	11 (64.7%)	
Lymphovascular invasion	Present	7	1 (5.3%)	6 (6.7%)	0 (0.0%)	0.60
	Not seen	118	18 (94.7%)	83 (93.3%)	17 (100.0%)	
Perineural invasion	Present	6	0 (0%)	6 (6.7%)	0 (0.0%)	0.22
	Not seen	119	19 (100%)	83 (93.3%)	17 (100.0%)	
DCIS component	Present	6	0 (0%)	6 (6.7%)	0 (0.0%)	0.22
	Not seen	119	19 (100%)	83 (93.3%)	17 (100.0%)	
Tumour border	Infiltrating	17	1 (5.3%)	14 (15.7%)	2 (11.8%)	0.37
	Not specified	108	18 (94.7%)	75 (84.3%)	15 (88.2%)	

Table 2 shows the distribution of histopathological features across tumor grades. Mild lymphocytic response was the predominant finding (109 cases) and showed no significant association with grade ($p=0.95$). Intratumoral necrosis was present in 43 cases and was more frequent in grade 3 tumors (58.8%) compared to grade 1 (21.1%) and grade 2 (32.6%) tumors ($p=0.02$). Desmoplasia demonstrated a significant association with tumor grade ($p=0.002$), with moderate desmoplasia observed in 76 cases. Microcalcification was present in 10 cases and did not show a significant association ($p=0.17$). Lymphovascular invasion (7 cases), perineural invasion (6 cases) and DCIS component (6 cases) were infrequent and showed no statistically significant relationship with grade. Tumor border characteristics were predominantly unspecified (108 cases), with infiltrative borders observed in 17 cases ($p=0.37$).

Table 3. Histopathological Diagnoses of Benign Breast Lesions (n=175).

Diagnosis	Frequency (n)	Percentage (%)
Chronic breast abscess	34	19.4
Fibrocystic disease	28	16.0
Fibroadenoma	22	12.6
Granulomatous mastitis with breast abscess	19	10.9
Fibrocystic disease with periductal mastitis	9	5.1



Granulomatous mastitis with abscess	7	4.0
Chronic breast abscess in a background of fibrocystic disease	4	2.3
Lactational change in a background of fibrocystic disease	3	1.7
Fat necrosis	3	1.7
Chronic breast abscess with periductal mastitis	3	1.7
Others	43	24.6

Table 3 outlines the distribution of benign breast lesions. Chronic breast abscess was the most common diagnosis (19.4%), followed by fibrocystic disease (16.0%) and fibroadenoma (12.6%). Granulomatous mastitis with abscess accounted for 10.9% of cases. Other combined inflammatory and fibrocystic conditions were less frequent. A heterogeneous group categorized as “others” comprised 24.6% of benign diagnoses.

Discussion

The present study provides a comprehensive overview of the histopathological spectrum of breast tumors in a tertiary care center in Bangladesh, encompassing both malignant and benign lesions. A notable finding was the higher mean age among patients with malignant tumors compared to those with benign lesions, with malignancy predominating in women aged 50 years and above. This age gradient aligns with global epidemiological patterns described by Sung et al., who reported increasing incidence with advancing age worldwide [1]. Similarly, Heer et al. demonstrated distinct age-related trends, with postmenopausal women bearing a substantial proportion of the global burden [6].

However, a considerable proportion of malignant cases in the present study occurred below 50 years, reflecting patterns observed in several low- and middle-income settings. Huang et al. noted rising incidence among younger women in certain regions, suggesting demographic and reproductive transitions as contributing

factors [7]. In Bangladesh, Ferdouse et al. documented delayed presentation and diagnostic intervals, which may further influence stage and pathological characteristics at diagnosis [20].

Laterality analysis revealed a slight right-sided predominance in malignant tumors, while benign lesions were more frequent in the left breast. Although laterality differences are generally modest and clinically less significant, similar distributions have been reported in other clinicopathological series. Aziz et al. observed unilateral predominance in most cases, with bilateral involvement being uncommon, consistent with our findings [21].

The histopathological evaluation of malignant tumors demonstrated that intratumoral necrosis and desmoplasia were significantly associated with higher tumor grade. Intratumoral necrosis was particularly frequent in grade 3 tumors. Feng et al. described necrosis as a marker of aggressive tumor biology, often reflecting hypoxia and rapid proliferation [13]. Makki also emphasized that high-grade tumors frequently exhibit necrosis and pronounced stromal reactions, correlating with adverse biological behavior [22]. The significant association between desmoplasia and tumor grade in this study supports the concept that stromal remodeling plays a central role in tumor progression, as outlined by Badve and Nakshatri, who highlighted tumor–stroma interactions as critical determinants of heterogeneity and aggressiveness [12].

In contrast, lymphocytic response did not show a statistically significant association with tumor grade. While tumor-infiltrating lymphocytes have been linked to prognostic and predictive implications in certain molecular subtypes, particularly triple-negative breast cancer, their distribution may vary depending on subtype composition and sample characteristics [23]. The absence of a significant association in this cohort may reflect heterogeneity in intrinsic subtypes, which were not stratified in this analysis.

Lymphovascular and perineural invasion were infrequent and did not demonstrate significant grade associations. Although lymphovascular invasion is widely recognized as an adverse prognostic indicator, its presence is not uniformly correlated with histological grade alone and may depend on tumor subtype and stage [15]. The relatively low frequency observed could be



related to sample composition or early-stage predominance.

Regarding benign lesions, chronic breast abscess and fibrocystic disease constituted the largest diagnostic categories, followed by fibroadenoma. This distribution contrasts with several hospital-based studies in which fibroadenoma was the leading benign lesion, particularly among younger women. For instance, Yogalakshmi and Kavitha reported fibroadenoma as the most common benign tumor in their series [19], while Kumbhakar and Talukdar similarly identified fibroadenoma as the predominant lesion [24]. The higher proportion of inflammatory lesions in the present study may reflect referral patterns, local healthcare-seeking behavior, or regional epidemiological differences.

Fibrocystic disease represented a substantial proportion of benign diagnoses, consistent with established data indicating that fibrocystic changes are among the most common non-neoplastic breast conditions. Dev et al. underscored the diagnostic challenges posed by fibrocystic disease due to its varied radiological and pathological manifestations [25]. The presence of granulomatous mastitis and abscess-related conditions also aligns with emerging regional reports. Amin et al. highlighted granulomatous mastitis as a clinically significant inflammatory condition in Bangladesh, often mimicking malignancy and requiring histopathological confirmation [26].

The wide heterogeneity observed within both malignant and benign categories reinforces the importance of meticulous pathological examination. Tan et al., in outlining the WHO classification framework, emphasized the evolving complexity of breast tumor categorization and the need for standardized reporting to ensure diagnostic precision [27]. Furthermore, Rakha et al. noted that accurate grading and morphological assessment remain fundamental to clinical decision-making, even in the era of molecular profiling [14].

From a broader perspective, the findings of this study contribute to the growing body of evidence highlighting the burden and diversity of breast pathology in resource-constrained settings. Iqbal discussed the challenges of cancer registration and health disparities in Bangladesh, underscoring the need for institution-based data to inform national strategies [10]. By delineating histopathological patterns and grade-associated features,

this study provides locally relevant evidence that may support improved diagnostic algorithms and management planning.

Limitations of the study

This single-center cross-sectional study may limit generalizability to the broader population. Molecular subtyping and long-term outcome data were not included, restricting correlation between histopathological features and survival or therapeutic response.

Conclusion

Breast tumors in this tertiary center demonstrated distinct age-related patterns and considerable histopathological heterogeneity. Malignancies were more frequent in older women and showed significant associations between higher grade and features such as intratumoral necrosis and desmoplasia. Benign lesions were diverse, with inflammatory and fibrocystic conditions predominating. These findings underscore the essential role of histopathological evaluation in accurate diagnosis and prognostic assessment.

Conflicts of interest: There are no conflicts of interest.

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