ORIGINAL ARTICLE

Correlation between Mammographic and Ultrasound Features and Histologic Grade in Patients with Breast Cancer

Boonyavee Hathaipiemsuk, MD[1], Wasu Tanasoontrarat, MD[1], Suwara Issaragrisil, MD[1]

[1] Division of Diagnostic Radiology, Department of Radiology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand

Objective: To provide insights into factors influencing radiographic features in the prediction of histologic tumor grade, which in turn affects disease prognosis and treatment planning.

Materials and Methods: This descriptive retrospective study involved imaging findings of 118 patients diagnosed with invasive ductal carcinoma whose diagnosis was confirmed through histopathological diagnosis based on tissue samples obtained during surgical procedures at the Faculty of Medicine, Vajira Hospital from December 2020 until December 2023.

Results: Mass shapes exhibited a statistically significant difference, with an oval shape being more likely to be observed in high-grade tumors (45.7%) than in low- or intermediate-grade tumors (18.8%) (p=0.008). In addition, high-grade tumors presented a significantly higher prevalence of posterior enhancement (21.2%) compared with low- or intermediate-grade tumors (10.0%), (p=0.04).

Conclusion: Our study revealed that malignant breast lesions typically exhibit an irregular shape, hypoechoic pattern with indistinct margins and posterior shadowing on ultrasound. Mammography revealed that malignant breast tumors were irregular, high-density masses with indistinct margins and fine pleomorphic calcifications with a segmental distribution. Notably, mammography revealed that an oval shape was more significantly observed for a high-grade tumor compared to low grade. Moreover, posterior enhancement showed statistical significance in high-grade tumors. Remarkably, high-grade tumors may display imaging features similar to those of a benign breast mass.

Keywords: Mammography; Ultrasound; Invasive ductal carcinoma; Breast carcinoma; Histological grade

Received 31 July 2024 | Revised 9 December 2024 | Accepted 18 December 2024

J Med Assoc Thai 2025;108(Suppl.1):S106-14

Website: http://www.jmatonline.com

Breast cancer represents the most common malignancy and cause of death in women in Thailand and around the world. The incidence of breast cancer has increased in Thailand and worldwide over the past 20 years and currently accounts for the highest incidence of all female cancers in Thailand with an age-standardized rate (World) of 37.4 cases per 100,000 person-years. The age-specific incidence of breast cancer is considerably less in Thailand than that in Western countries. In addition, a trend of steady increase in number of younger patients or those in premenopausal age group has been observed[1-3].

Correspondence to:

Hathaipiemsuk B.

Department of Radiology Vajira Hospital 681 Samsen Road, Wachira Phayaban, Dusit, Bangkok 10300, Thailand.

Phone: +66-2-2443000

Email: boonyavee.work@gmail.com, boonyavee@nmu.ac.th

How to cite this article:

Hathaipiemsuk B, Tanasoontrarat W, Issaragrisil S. Correlation between Mammographic and Ultrasound Features and Histologic Grade in Patients with Breast Cancer. J Med Assoc Thai 2025;108(Suppl.1):S106-14.

DOI: 10.35755/jmedassocthai.2025.S01.S106-S114

Mammography plays a crucial role in screening and diagnosis of breast cancer, allowing early stage detection, which in turn increases chance of successful treatment[4]. However, in screening for breast cancer in women with a considerable amount of breast tissue, the likelihood of missing abnormalities is higher compared with that in women with less breast tissue[5]. The combination of ultrasound and mammography is beneficial for screening of such cases[6,7].

Invasive ductal carcinoma (IDC) is the most commonly found type of breast cancer, and it accounts for up to 80% of all breast cancers. Its aggressive form, which is Grade 3 or poorly differentiated carcinoma, approximately accounts for 51.8% of cases based on a study of 88 Japanese patients[8]. Mammography reveals diverse patterns, including cancerous and noncancerous types, in breast tissue. A spiculated mass has been observed with a positive predictive value of approximately 90%[9,10], and a well-defined circumscribed mass often shows association with noncancerous breast tissues, such as fibroadenoma, cyst, or hamartoma[11]. However, well-defined circumscribed masses can also be indicative of breast cancer, which lowers the

precision of diagnosis solely based on mammography[11].

Ultrasound breast examination provides a high diagnostic accuracy for IDC (up to 94%)[12]. Ultrasound images of patients with IDC most commonly display mass characteristics, such as hypoechogenicity, angular margin, spiculated appearance, or microlobulated margins[13].

The histologic tumor grades of IDC is in accordance with the Nottingham grading system[14]. These grades comprise Grade 1 (low-grade or well-differentiated type), Grade 2 (intermediate grade or moderately-differentiated type), and Grade 3 (high grade or poorly-differentiated type). Various radiographic appearances are associated with these grades.

The Breast Imaging Reporting and Data System (BI-RADS), which is widely used by radiologists today, was developed by the American College of Radiology as a standardized reporting system for mammography and ultrasound images[15]. Currently, the Diagnostic Radiology Unit of the Department of Radiology takes charge of screening examinations for Thai women without symptoms and patients with abnormal symptoms, such as palpable breast or axillary masses, breast pain, nipple discharge, or other abnormalities. The screening involves mammography and ultrasound examinations, and the results are reported using the BI-RADS system. Results indicating a BI-RADS category of 4 or 5 require the need for a histopathological diagnosis. Patients with confirmed cancer diagnosis undergo surgery for further treatment. The present study aimed to determine the relationship between mammography and ultrasound images revealing the histopathology of breast cancer patients, specifically focusing on IDC. The histologic tumor grade was determined in accordance with the Nottingham grading system, and radiographic findings were assessed using the BI-RADS lexicon 5th edition. The present study aimed to provide insights into the factors influencing both radiographic imaging methods in the prediction of histologic tumor grade, which in turn affects disease prognosis and treatment planning.

Materials and Methods

A descriptive retrospective study was conducted at Vajira Hospital, Bangkok, Thailand. All asymptomatic female patients, as well as female patients with abnormal symptoms such as palpable breast masses, breast pain, nipple discharge, or other anomalies, underwent examinations with complete both mammography and ultrasound. Patients diagnosed with IDC whose diagnosis was confirmed through histopathological diagnosis based on tissue samples obtained during surgical procedures at the Faculty of Medicine, Vajira Hospital, starting, from December 2020 until December 2023, were eligible for enrollment in the present study. Recruitment was performed until the target sample size was achieved. From the available data, it has been observed that 20 to 30 patients are diagnosed with IDC each year in Vajira Hospital.

The demographic data, including past medical history, indication of undergoing mammography (whether for screening or diagnosis), mammographic and ultrasound findings, BI-RADS category, and histological tumor grading in accordance with the Nottingham grading system, were recorded. Patients with incomplete medical record data or imaging were excluded.

The present study was approved by the Institutional Review Board of the Faculty of Medicine, Vajira Hospital, Bangkok, Thailand (Study code 028/64E).

Statistical analysis

Statistical analysis was performed using SPSS Statistics version 29.0 (IBM Corp, Armonk, NY, USA).

The sample size determination in this study is calculated from the proportion in population or the true proportion which reference by the study "Mammography and ultrasound features of triple-negative breast cancer" by Yasuyuki Kojima and Hiroko Tsunoda[8], with a type I error of 0.05 and precision of 0.1.

Qualitative data, including BI-RADS category, histological tumor grade, and the rate of breast cancer diagnosis in asymptomatic Thai women, including female patients with abnormal breast symptoms, are expressed as mean with standard deviation (SD) and percentage distribution. Chi-square test and Fisher's exact test were conducted on the differences in mammographic and ultrasound features between low to intermediate and high histological grade tumors. Univariate and multivariate analyses were performed using the logistic regression model. The p-values less than 0.05 were considered statistically significant.

Results

The present study included 118 patients, whose mean age was approximately 62.1 years (±12.2). Most patients among the study population underwent mammography for diagnostic indications (83.1%) and screening purposes (16.9%) (Table 1).

Histological grades were distributed as follows: 12 (10.2%) grade 1 (low-grade or well-differentiated type) tumors, 59 (50%) grade 2 (intermediate grade or moderately-differentiated type) tumors, and 47 (39.8%) grade 3 (high grade or poorly differentiated type) tumors (Table 2).

Ultrasound images were available for 117 cases. One case presented abnormal microscopic calcification and no ultrasonographic abnormality. The majority of tumors depicted irregular shape (70.9%), taller than wide appearance (70.9%), indistinct margin (47.9%), hypoechoic

Table 1. Patients characteristic data (n=118)

Characteristic data	n (%)
Age (years): mean ± SD (range)	62.1±12.2 (35, 87)
Indication	
Screening	20 (16.9%)
Diagnostic	98 (83.1%)
Palpable breast lump	61
Palpable axillar mass	25
Nipple discharge	4
Mastalgia	4
No data	4

Table 2. Histological tumor grade

Histological tumor grade	n=118
Grade 1 (low grade or well-differentiated type)	12 (10.2%)
Grade 2 (intermediate grade or moderately-differentiated type)	59 (50.0%)
Grade 3 (high grade or poorly differentiated type)	47 (39.8%)

appearance (77.7%), lack of posterior feature (53.9%), and internal vascularity (46.6%) (Table 3). No significant relationship was observed between these characteristic and histological grades. The mean of the tumor size was approximately 3.2 cm (SD (range) ±2.1 (0.1, 17)).

Among tumors with posterior features, 54 tumors (46.1%) exhibited posterior shadowing as the most common finding (25.6%), followed by posterior enhancement (14.5%) and a combined pattern (6%). Based on histological grading in low or intermediate grade, posterior shadowing was observed in 34.3%, posterior enhancement in 10.0%, and a combined pattern in 5.7% of cases. In high-grade tumors, posterior enhancement was noted in 21.2% (Figure 1) of patients, posterior shadowing in 12.8%, and a combined pattern in 6.4%. A echogenic rind was noted in 42.7% of all case, but this finding had no significant relation to the histological grade.

Mammograms were available for 118 cases (Table 4), of which 115 revealed the presence of a mass on mammography and 2 cases was demonstrated mass on ultrasound. A total of 71 cases were classified under low- or intermediate-grade and 47 cases belonged to the high-grade category. Most of the tumors exhibited a high density and irregular shape with an indistinct margin. Microcalcification was detected in approximately 58 cases (49.2%), divided by type, namely, fine pleomorphic (51.8%), amorphous (15.5%), coarse heterogenous (12.1%), fine linear (8.6%), round (8.6%), and coarse or popcorn-like calcification (3.4%), with distribution as segmental (50%), regional (24.2%), group (15.5%), and linear (8.6%).

One mammographic characteristic displayed statistical significance when correlated with histologic grade, which

Table 3. Ultrasound finding

Ultrasound	
Shape	
Oval	33 (28.2%)
Round	1 (0.9%)
Irregular	83 (70.9%)
Orientation	
Parallel	34 (29.1%)
Not parallel	83 (70.9%)
Margin	
Circumscribed	1 (0.9%)
Not circumscribed indistinct	49 (41.9%)
Angular	20 (17.1%)
Microlobulated	28 (23.9%)
Spiculated	19 (16.2%)
Echo pattern	
Anechoic	-
Hyperechoic	7 (6.0%)
Complex cystic and solid	1 (0.9%)
Hypoechoic	91 (77.7%)
Isoechoic	-
Heterogeneous	18 (15.4%)
Posterior features	
No posterior feature	63 (53.9%)
Enhancement	17 (14.5%)
Shadowing	30 (25.6%)
Combined pattern	7 (6.0%)
Calcifications	
No calcification in a mass	72 (61.5%)
Presence of calcifications in a mass	44 (37.6%)
Intraductal calcifications	1 (0.9%)
Associated features	
Architectural distortion	11 (9.3%)
Duct changes	4 (3.4%)
Skin changes-Skin thickening	8 (6.8%)
Skin retraction	5 (4.2%)
Edema	-
Vascularity-absent	4 (3.4%)
Internal vascularity	55 (46.6%)
Vessels in rim	8 (6.8%)
Elasticity assessment-soft	1 (0.8%)
Intermediate	-
Hard	4 (3.4%)
Echogenic rind	
No	67 (57.3%)
Yes	50 (42.7%)

was the tumor shape. Among low- or intermediate-grade tumors, 69.6% of cases showed an irregular shape, 18.8% were oval shape, and 11.6% were round shape. A total of 45.7% of cases of high-grade tumors presented an irregular

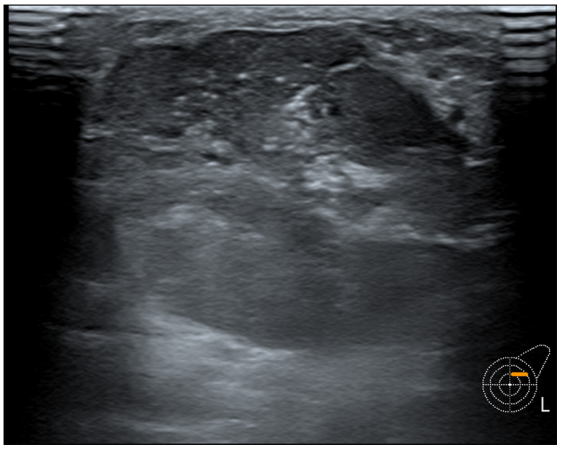

Figure 1. Posterior enhancement associated with a high grade (grade 3) invasive ductal carcinoma.

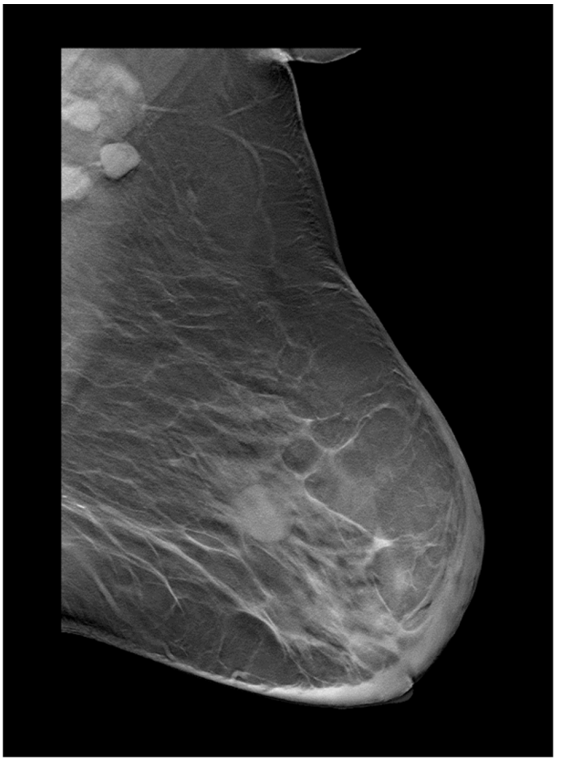

Figure 2. A high grade (grade 3) invasive ductal carcinoma producing an oval shape mass on mediolateral oblique view on tomosynthesis.

shape, 45.7% had oval shape, and 8.6% had round shape (Table 5, 6). In our study, low- or intermediate-grade tumors exhibited an irregular shape appearance, whereas an oval shape appearance was more common in high-grade tumors (p=0.008) (Figure 2). Univariate and multivariate logistic regression analyses revealed oval-shaped tumor as having a higher likelihood of being a high-grade tumor compared with a tumor with irregular shape.

Table 4. Mammographic finding

Mammographic	
Breast composition	
Almost entirely fat	6 (5.1%)
Scattered areas of fibroglandular density	30 (25.4%)
Heterogeneously dense	68 (57.6%)
Extremely dense	14 (11.9%)
Mass	
No	3 (2.5%)
Yes	115 (97.5%)
Mass size: mean ± SD (range)	3.2±2.1 (0.1, 17)
Shape	
Oval	34 (29.6%)
Round	12 (10.4%)
Irregular	69 (60.0%)
Margin	
Circumscribed	8 (7.0%)
Obscured	9 (7.8%)
Microlobulated	24 (20.9%)
Indistinct	57 (49.6%)
Spiculated	17 (14.7%)
Density	
High density	74 (64.4%)
Equal density	39 (33.9%)
Fat-containing	2 (1.7%)
Calcification	
No	60 (50.8%)
Yes	58 (49.2%)
Type of calcification	
Typically benign: Coarse or popcorn-like	2 (3.4%)
Round	5 (8.6%)
Suspicious morphology: Amorphous	9 (15.5%)
Coarse heterogeneous	7 (12.1%)
Fine pleomorphic	30 (51.8%)
Fine linear	5 (8.6%)
Distribution	
Diffuse	1 (1.7%)
Regional	14 (24.2%)
Grouped	9 (15.5%)
Linear	5 (8.6%)
Segmental	29 (50.0%)
Asymmetry	
No	112 (94.9%)
Yes: Focal asymmetry	6 (5.1%)
Solitary dilated duct	
No	111 (94.1%)
Yes	7 (5.9%)

Discussion

Previous research has explored the relationship between mammography images and the histopathology of breast cancer patients, often yielding inconclusive and

Table 4. Cont.

Mammographic	
Associated features	
Skin retraction	14 (11.9%)
Nipple retraction	24 (20.3%)
Skin thickening	27 (22.9%)
Trabecular thickening	5 (4.2%)
Axillary lymphadenopathy	37 (31.4%)

Figure 3. Echogenic rind in a high grade (grade 3) invasive ductal carcinoma.

inconsistent results[16-18]. Lamb et al., in a study on 120 patients, and Sturesdotter et al., in a research involving 1,116 patients, discovered a correlation between spiculated mass morphology in mammography and low- or intermediate-grade tumors[16,18]. By contrast, our study revealed that an oval shape morphology in mammography was statistically significant in indicating a high-grade tumor compared with an irregular shape appearance, which can be misinterpreted as a benign lesion.

In addition, Lamb et al. investigated the relationship between ultrasound images and tumor grades and discovered that features like acoustic shadowing were associated with low- or intermediate-grade tumors, while features like acoustic enhancement and well-defined margins were related to high-grade tumors[16]. Correspondingly, our study indicated that high-grade tumors showed more posterior enhancement (21.2%) compared with low- or intermediate-grade tumors (10.0%). The most common posterior feature in low- or intermediate-grade tumors was posterior shadowing (34.3%), and in high-grade tumors, the value was 12.8%, which was statistically significant (p=0.042). However, Watermann et al., in a study on 337 patients, failed to find a significant relationship between ultrasound images and the histopathology of breast cancer patients[17]. Lamb et al. also revealed that tumor size was statistically significant when correlated with histological grades; however, our study did not find a correlation between the increase in tumor size and histological grade.

The term "echogenic rind" was introduced to aid in the prediction of malignancy. An echogenic rind refers to a sonographic feature characterized by a hyperechoic (bright) outer rim surrounding a breast lesion, and it indicates an increase in the echogenicity on the mass's periphery (Figure 3)[19,20]. In Parada-Gallardo et al.'s study, the positive predictive value of the presence of an echogenic rind in the prediction of malignancy was 85.7% (95% confidence interval (CI): 60.1 to 96.0), and the negative predictive value was 92.5% (95% CI: 82.1 to 97.0)[21]. Our study, revealed quite high prevalence of an echogenic rind in 42.7% of all cases, with 42.9% categorized as low- or intermediate-grade tumors and 42.6% as high-grade tumors, with no statistical significance (Table 5).

Conclusion

Regardless of histological grade, most tumors exhibited an irregular shape, hypoechoic pattern with indistinct margins and posterior shadowing on ultrasound and mammography revealed irregular shaped tumors, high density mass with indistinct margins, and fine pleomorphic calcifications with segmental distribution. Noteworthy findings, not all malignant tumors exhibit the feature of an echogenic rind on ultrasound. However, if the feature of an echogenic rind is present on ultrasound, the mass is almost always malignant.

The statistically significant mammographic oval shape appearance in high-grade tumors and 21.2% of cases exhibiting posterior acoustic enhancement in high-grade tumors, which both oval shape and posterior acoustic enhancement are similar to those of benign lesions, should raise consideration regarding interpretation of this finding. Radiologists should carefully interpret and explore other features that may indicate malignancy.

Regardless, in our study, most of the mammographic and ultrasonographic findings revealed no statistically significant differences between these characteristics and histological grades. All solid lesions obtaining during ultrasound and mammography should therefore be subject to cytological or histological sampling for accurate histological grading.

What is already known on this topic?

The typical mammographic features for breast cancer are including high density mass with irregular shape and

Table 5. The difference in mammographic and ultrasound features between Low to intermediate and high histological grade by Chi-square test and Fisher's exact test

Characteristic data	Low + Intermediate (n=71)	High (n=47)	p-value
Age (years): mean ± SD (range)	63.3 ± 12.5	60.3 ± 11.7	0.199
Indication			0.628
Screening	13 (18.3%)	7 (14.9%)	
Diagnostic	58 (81.7%)	40 (85.1%)	
Palpable breast lump	35	26	
Palpable axillar mass	17	8	
Nipple discharge	3	1	
Mastalgia	1	3	
Mammographic			
Breast composition			0.565
Almost entirely fat	4 (5.6%)	2 (4.3%)	
Scattered areas of fibro glandular density	15 (21.1%)	15 (31.8%)	
Heterogeneously dense	44 (62.0%)	24 (51.1%)	
Extremely dense	8 (11.3%)	6 (12.8%)	
Mass			1.000
No	2 (2.8%)	1 (2.1%)	
Yes	69 (97.2%)	46 (97.9%)	
Mass size: mean ± SD (range)	3.1 ± 2.3	3.4 ± 1.8	0.405
Shape			0.008
Oval	13 (18.8%)	21 (45.7%)	
Round	8 (11.6%)	4 (8.6%)	
Irregular	48 (69.6%)	21 (45.7%)	
Margin			0.111
Circumscribed	3 (4.3%)	5 (10.9%)	
Obscured	8 (11.6%)	1 (2.2%)	
Microlobulated	14 (20.4%)	10 (21.7%)	
Indistinct	31 (44.9%)	26 (56.5%)	
Spiculated	13 (18.8%)	4 (8.7%)	
Density			0.057
High density	39 (56.5%)	35 (76.1%)	
Equal density	28 (40.6%)	11 (23.9%)	
Fat-containing	2 (2.9%)	0 (0%)	
Calcification			0.735
No	37 (52.1%)	23 (48.9%)	
Yes	34 (47.9%)	24 (51.1%)	
Type of calcification			0.550
Typically benign: Coarse or popcorn-like	1 (2.9%)	1 (4.2%)	
Round	4 (11.8%)	1 (4.2%)	
Suspicious morphology: Amorphous	6 (17.7%)	3 (12.5%)	
Coarse heterogeneous	4 (11.8%)	3 (12.5%)	
Fine pleomorphic	18 (52.9%)	12 (50.0%)	
Fine linear	1 (2.9%)	4 (16.6%)	

spiculated margin and typical ultrasonographic features for breast cancer are included hypoechoic mass with irregular shape, spiculated margin and posterior shadow.

What this study adds?

Our study shows that an oval shape appearance on mammography is more significantly observed in high-grade tumors compared to low-grade tumors. Moreover, posterior enhancement shows statistical significance in high-grade tumors. These two characteristics are common in benign breast tumors and may confuse radiologists. Thus, radiologists should carefully interpret these findings and

Table 5. Cont.

Characteristic data	Low + Intermediate (n=71)	High (n=47)	p-value
Distribution			0.873
Diffuse	1 (2.9%)	0 (0%)	
Regional	8 (23.6%)	6 (25.0%)	
Grouped	6 (17.6%)	3 (12.5%)	
Linear	2 (5.9%)	3 (12.5%)	
Segmental	17 (50.0%)	12 (50.0%)	
Asymmetry			0.400
No	66 (93.0%)	46 (97.9%)	
Yes: Focal asymmetry	5 (7.0%)	1 (2.1%)	
Solitary dilated duct			1.000
No	67 (94.4%)	44 (93.6%)	
Yes	4 (5.6%)	3 (6.4%)	
Associated features			
Skin retraction	7 (9.9%)	7 (14.9%)	0.408
Nipple retraction	14 (19.7%)	10 (21.3%)	0.837
Skin thickening	17 (23.9%)	10 (21.3%)	0.736
Trabecular thickening	2 (2.8%)	3 (6.4%)	0.386
Axillary lymphadenopathy	23 (32.4%)	14 (29.8%)	0.765
Characteristic data	Low + Intermediate (n=70)	High (n=47)	p-value
Ultrasound			
Shape			0.392
Oval	17 (24.3%)	16 (34.0%)	
Round	1 (1.4%)	0 (0%)	
Irregular	52 (74.3%)	31 (66.0%)	
Orientation			0.165
Parallel	17 (24.3%)	17 (36.2%)	
Not parallel	53 (75.7%)	30 (63.8%)	
Margin			
Circumscribed	1 (1.4%)	0 (0%)	1.000
Not circumscribed indistinct	25 (35.8%)	24 (51.1%)	0.186
Angular	15 (21.4%)	5 (10.6%)	0.129
Microlobulated	14 (20.0%)	14 (29.8%)	0.224
Spiculated	15 (21.4%)	4 (8.5%)	0.063
Echo pattern			0.252
Anechoic	-	-	
Hyperechoic	2 (2.9%)	5 (10.6%)	
Complex cystic and solid	1 (1.4%)	0 (0%)	
Hypoechoic	55 (78.6%)	36 (76.6%)	
Isoechoic	-	-	
Heterogeneous	12 (17.1%)	6 (12.8%)	
Posterior features			0.042
No posterior features	35 (50.0%)	28 (59.6%)	
Enhancement	7 (10.0%)	10 (21.2%)	
Shadowing	24 (34.3%)	6 (12.8%)	
Combined pattern	4 (5.7%)	3 (6.4%)	
Calcifications			0.538
No calcification in a mass	44 (62.9%)	28 (59.6%)	
Presence of calcifications in a mass	26 (37.1%)	18 (38.3%)	

Table 5. Cont.

Characteristic data	Low + Intermediate (n=71)	High (n=47)	p-value
Intraductal calcifications	0 (0%)	1 (2.1%)	
Associated features			
Architectural distortion	6 (8.5%)	5 (10.6%)	0.752
Duct changes	2 (2.8%)	2 (4.3%)	1.000
Skin changes-Skin thickening	5 (7.0%)	3 (6.4%)	1.000
Skin retraction	5 (7.0%)	0 (0%)	0.156
Edema	-	-	-
Vascularity-absent	3 (4.2%)	1 (2.1%)	1.000
Internal vascularity	34 (47.9%)	21 (44.7%)	0.732
Vessels in rim	6 (8.5%)	2 (4.3%)	0.474
Elasticity assessment-soft	0 (0%)	1 (2.1%)	0.398
Intermediate	-	-	-
Hard	3 (4.2%)	1 (2.1%)	1.000
Absent associated feature	6 (8.5%)	11 (23.4)	
Echogenic rind			0.974
No	40 (57.1%)	27 (57.4%)	
Yes	30 (42.9%)	20 (42.6%)	

Table 6. The correlation between mammographic and ultrasound features and histological grade by logistic regression

Characteristic data	Univariable analysis		Multivariable analysis	
	Unadjusted odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value
Mammographic				
Shape				
Irregular	Ref.		Ref.	
Oval	3.692 (1.561, 8.735)	0.003	3.173 (1.101, 9.146)	0.033*
Round	1.143 (0.310, 4.215)	0.841	1.462 (0.310, 6.898)	0.499
Margin				
Spiculated	Ref.		Ref.	
Circumscribed	5.417 (0.880, 33.36)	0.069	1.815 (0.189, 17.41)	0.605
Obscured	0.406 (0.038, 4.310)	0.455	0.148 (0.010, 2.174)	0.163
Microlobulated	2.321 (0.582, 9.261)	0.233	0.742 (0.130, 4.244)	0.738
Indistinct	2.726 (0.792, 9.381)	0.112	1.195 (0.274, 5.207)	0.812
Density				
Equal density	Ref.		Ref.	
High density	2.284 (0.993, 5.257)	0.057	1.995 (0.759, 5.241)	0.161
Fat-containing	N/A		N/A	
Ultrasound				
Margin				
Angular	0.437 (0.147, 1.297)	0.136	0.515 (0.151, 1.761)	0.290
Spiculated	0.341 (0.106, 1.102)	0.072	0.608 (0.142, 2.609)	0.504
Posterior features				
No posterior features	Ref.		Ref.	
Enhancement	1.786 (0.603, 5.291)	0.295	1.208 (0.349, 4.180)	0.765
Shadowing	0.313 (0.112, 0.870)	0.026	0.392 (0.117, 1.315)	0.130
Combined pattern	0.938 (0.194, 4.539)	0.936	1.478 (0.242, 9.028)	0.672

keep in mind that when solid lesions reveal an oval shape appearance on mammography and posterior enhancement on ultrasound, the lesion is not always benign. Radiologists should look for other features that may indicate malignancy.

Conflicts of interest

The authors declare no conflict of interest.

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