ОРИГИНАЛЬНАЯ СТАТЬЯ

EVALUATION OF NON-MASS AREA IN BREAST ULTRASOUND WITH PATHOLOGIC CORRELATION

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Breast tumors are common in women. Breast non-mass lesions (NML) is a new term that describes breast abnormalities on ultrasound.

Purpose. To evaluate the variable imaging appearance of NMLs in breast ultrasound and its correlation with pathological results, and to provide a standardized approach to NMLs in breast ultrasound.

Materials and methods. A cross-sectional study was conducted at the Outpatient Breast Clinic of Oncology Teaching Hospital at Medical Complex in Baghdad city/Iraq for a period of ten months from 1st of June, 2024 to 31st of March, 2025, on a sample of 60 women with breast NMLs. Breast NML was characterized by an experienced breast imaging radiologist. The diagnosis of malignancy was confirmed via histopathological examination.

Results. The ultrasound BI-RADS categories of breast NMLs were BI-RADS 4A (35%), BI-RADS 4 B (51.7%), and BI-RADS 4C (13.3%). Histopathology revealed that 40% of NMLs were malignant, 15% were benign with upgrade potential (BUP), and 45% were benign tumors. The most common malignant breast non-mass lesion was ductal carcinoma in situ and the most common benign non-mass lesion was fibroadenosis. A significant association was observed between the segmental distribution of NML, associated architectural distortion, echogenic dots (microcalcification), increased vascularity, and posterior shadowing with malignancy ($p \leq 0.05$). Cystic changes in NMLs are predictive of benign lesions.

Discussion. The present study showed that the ultrasound characteristics of malignant NMLs were significantly segmental distribution, associated architectural distortion, echogenic dots, increased intralesional vascularity, and posterior shadowing ($p \leq 0.05$). These findings are consistent with the results of different studies, such as Park et al. retrospective study in South Korea and Guo et al. retrospective study in China, which documented a significant correlation between architectural distortion, microcalcification, increased vascularity, and posterior shadowing in ultrasound with malignancy of breast NMLs. In our study, a highly significant association was observed between small cystic changes on ultrasound of the breast NML and benign tumors ($p<0.001$). A review by Tsunoda and Moon in South Korea consistently reported that ultrasound findings of cystic changes are predictive of benign breast NML.

Conclusion. Breast non-mass lesions are a new and important descriptor in breast ultrasonography. Ultrasound characteristics of segmental distribution of breast non-mass lesions, presence of architectural distortion, echogenic dots (microcalcification), increased vascularity, and posterior shadowing are predictive of malignant breast NMLs and a high probability of malignancy with corresponding imaging correlates on mammography as asymmetry or distortion.

Keywords: breast NMLs, ultrasound, BI-RADS, microcalcification, architectural distortion.

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ОЦЕНКА НЕОПУХОЛЕПОДОБНЫХ ИЗМЕНЕНИЙ ПРИ УЛЬТРАЗВУКОВОМ ИССЛЕДОВАНИИ МОЛОЧНЫХ ЖЕЛЕЗ С ПАТОМОРФОЛОГИЧЕСКОЙ КОРРЕЛЯЦИЕЙ

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Цель. Опухоли молочной железы являются распространённой патологией у женщин. Термин «неопухолеподобные изменения молочной железы» (non-mass lesions, NML) – относительно новый и используется для описания аномалий молочной железы при ультразвуковом исследовании.

Цель исследования. Оценить различные варианты ультразвуковой картины неопухолеподобных изменений молочной железы и их корреляцию с патоморфологическими результатами, а также предложить стандартизированный подход к описанию NML при ультразвуковом исследовании.

Материалы и методы. Было проведено поперечное исследование на базе амбулаторного маммологического кабинета Онкологической клинической больницы Медицинского комплекса в Багдаде (Ирак) в течение десяти месяцев – с 1 июня 2024 г. по 31 марта 2025 г. В исследование включены 60 женщин с NML молочной железы. Характеристика изменений проводилась опытным рентгенологом, специализирующимся на диагностике заболеваний молочных желез. Диагноз злокачественного процесса подтверждался при гистопатологическом исследовании.

Результаты. По данным ультразвукового исследования non-mass изменения молочной железы распределялись по категориям BI-RADS следующим образом: BI-RADS 4A – 35%, BI-RADS 4B – 51,7%, BI-RADS 4C – 13,3%. При гистопатологическом анализе выявлено, что 40% NML являлись злокачественными, 15% – доброкачественными с потенциалом прогрессии (benign with upgrade potential, BUP), а 45% соответствовали доброкачественным опухолям. Наиболее частым злокачественным вариантом NML был протоковый рак in situ, наиболее частым доброкачественным – фиброаденоз. Выявлена значимая ассоциация между сегментарным типом распространения, наличием архитектонических искажений, эхогенными точками (микрокальцинатами), усилением васкуляризации и задним акустическим ослаблением со злокачественными процессами ($p \leq 0,05$). Кистозные изменения в структуре NML предсказывали доброкачественный характер процесса.

Обсуждение. В настоящем исследовании показано, что ультразвуковыми признаками злокачественных NML являются сегментарное распределение, архитектонические искажения, эхогенные точки, повышенная васкуляризация и заднее акустическое ослабление ($p \leq 0,05$). Эти данные согласуются с результатами ретроспективных исследований Park и соавт. (Южная Корея) и Guo и соавт. (Китай), которые также продемонстрировали достоверную корреляцию между архитектоническими искажениями, микрокальцинатами, усилением кровотока, задним акустическим ослаблением и злокачественностью NML молочной железы. В нашем исследовании выявлена выраженная ассоциация между наличием мелких кистозных изменений при УЗИ NML и доброкачественными образованиями ($p < 0,001$). Обзор Tsunoda и Moon (Южная Корея) также подтверждает, что ультразвуковые признаки кистозной перестройки предсказывают доброкачественный характер NML молочной железы.

Заключение. Неопухолеподобные изменения молочной железы являются новым и важным дескриптором при ультразвуковой диагностике. Ультразвуковые признаки сегментарного распространения, архитектонических искажений, эхогенных точек (микрокальцинатов), усиления васкуляризации и заднего акустического ослабления достоверно ассоциированы со злокачественными NML молочной железы, при этом высокая вероятность злокачественного процесса подтверждается также маммографическими коррелятами в виде асимметрии или деформации.

Ключевые слова: неопухолеподобные образования молочной железы, ультразвуковое исследование, BI-RADS, микрокальцинаты, нарушение архитектоники.

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Most breast abnormalities identified on ultrasound (US) are three-dimensional (3D) masses that are distinguished by their shape, margin, orientation, echo pattern, and posterior features. However, some discrete findings observed in practice do not meet these criteria for masses, leading to the US concept of "non-mass lesions". The features and outcomes of screening and diagnostic US have been investigated in several studies by Asian researchers. Currently, non-mass lesions are not included in the American College of Radiology (ACR) Breast Imaging Reporting and Data System (BI-RADS) (5th edition). However, in Japan, US findings of breast lesions have been divided into mass and non-mass since the 1980s. Guidelines including the definition, classifications, and differential diagnoses of masses and non-mass abnormalities have been published and updated by the Japan Society of Ultrasonics in Medicine and the Japan Association of Breast and Thyroid Sonology (JABTS). Although non-mass abnormalities in the JABTS guidelines are different and more comprehensive than those mentioned in recent studies, it is necessary to understand these features to further discuss the non-mass concept [1].

There is considerable overlap between the US features of benign and malignant breast NMLs. In previous routine clinical practice, except for a few NMLs classified as BI-RADS category 0, all other NMLs were classified as a certain category. This results in inappropriate malignancy risk stratification of breast masses and NMLs. Therefore, one or more reliable and non-invasive US findings that could reduce the number of unnecessary procedures would be valuable. There are several descriptions of breast NMLs on US, but none of them have been adopted in consensus [2, 3]. To date, the knowledge and understanding of breast NMLs in the US are still insufficient. A previous study showed that US BI-RADS exhibited high efficacy for the assessment of breast masses, with a sensitivity of 92%, specificity of 85%, and accuracy of 87% for BI-RADS 3-5 lesions [4]. However, there is no protocol for malignancy risk assessment of breast NMLs.

This study provides a focused evaluation of ultrasound BI-RADS classification specifically for breast non-mass lesions (NMLs), an area that remains underexplored compared to mass lesions. This study provides novel insights into the diagnostic reliability of BI-RADS subcategories (4A–4C) in predicting malignancy among NMLs, particularly within a tertiary care center in Iraq, thereby addressing regional variations in presentation and pathology. The study also correlates specific ultrasound and mammographic features with histopathological outcomes, helping to refine noninvasive diagnostic pathways.

This study aimed to assess the diagnostic value and reliability of ultrasound BI-RADS classification in the evaluation of breast non-mass lesions (NMLs) by correlating imaging findings (ultrasound and mammography) with histopathological results. This study also aimed to determine the prevalence of benign and malignant NMLs, identify key imaging features associated with malignancy, and evaluate the validity (sensitivity and specificity) of BI-RADS categories in guiding biopsy and management decisions.

Methods.

Study design & settings.

A cross-sectional study was carried out at the Breast Imaging Clinic of Oncology Teaching Hospital at the Medical City Complex in Baghdad city/Iraq for a period of ten months from 1st of June, 2024 to 31st of March, 2025.

Study population.

All female patients who presented to the Outpatient Breast Clinic of Oncology Teaching Hospital for screening or diagnostic purposes and breast NMLs (NMLs) detected on breast US were the study population.

Inclusion criteria:

1. The patient underwent breast ultrasound due to pain, palpable abnormality, or nipple discharge with the detection of NML on ultrasound.

2. histopathological correlation available (e.g., biopsy, core biopsy or surgical excision).

Exclusion criteria:

1. Lesions meeting the BI-RADS criteria for mass lesions (i.e., clearly defined margins, 3D shape).

2. Lack of histopathological conformation

or in-sufficient data.

3. Breast lesions seen only on mammography without ultrasound finding of non-mass appearances.

4. Pregnant or lactating female

5. History of previous breast surgery or radiotherapy

Sampling.

The study sample included 60 women who presented to the Outpatient Breast Clinic of Oncology Teaching Hospital with breast NMLs on breast ultrasound, according to the inclusion and exclusion criteria.

Data Collection.

The data were collected by the researcher directly from the selected women and filled in a questionnaire. An experienced breast radiologist designed the questionnaire. The questionnaire included the following questions.

1. Age of women with NMLs.

2. side and site of NMLs.

3. Ultrasound characteristics of NMLs: Distribution, orientation, echo pattern, architectural distortion, echogenic dots (microcalcification), vascularity, cystic changes, and posterior shadowing.

4. Ultrasound BIRADS of women with NMLs (IVA-IVC).

5. Corresponding Mammography findings of women with NMLs in US: Focal asymmetry, architectural distortion, and microcalcification.

6. Histopathology findings of NMLs: Malignant, BUP and benign findings.

Ultrasound appearance of breast non-mass lesion.

Ultrasonography was performed by an experienced breast imaging subspecialty radiologist. The ultrasound machine (GE LOGIC S8) was manufactured in 2019. All included patients underwent mammography examination, either screening (completed by complementary US in the indicated cases) or diagnostic mammography. Mammography was performed by a specialist operator using GE Healthcare Seno essential digital mammography, and the interpretation was performed by an experienced breast radiologist.

Characterization of breast non-mass area in US done according to the following parameters

• Distribution: regional, linear, segmental, and focal (according to orientation regarding the nipple and involved area)

• Orientation: parallel or antiparallel (relative to skin).

• Echogenicity: isoechoic, hypoechoic, hyperechoic, mixed.

• Echogenic dots

• Vascularity

• Posterior shadowing

• Small Cystic changes

Mammographic images were assessed and analyzed, and the findings were categorized as focal asymmetry, architectural distortion, or microcalcification (or mass if present).

BI-RADS assessment was based on a combination of US and mammographic findings. The BI-RADS category was assigned based on the ACR BI-RADS Atlas, 5th edition.

breast non-mass lesions are usually considered suspicious findings (BI-RADS 4), as they may be caused by benign, malignant, or BUP, and should therefore be biopsied. Non-mass breast lesions were classified into BI-RADS 4A, 4 B, and 4C according to their imaging appearance on US and mammography, and their degree of suspicion. US-guided biopsy was performed by a breast radiologist and the specimen was examined by histopathologists experienced in breast pathology.

Ethical considerations.

Ethical approval was obtained from the Ethical Committee of the Department of Radiology, College of Medicine, University of Baghdad (No. 402 on July 8, 2024). An official agreement was obtained from hospital authorities. Verbal consent was obtained from all women after explaining the aim of the study and ensuring confidentiality.

Statistical analysis.

Statistical Package for Social Sciences (SPSS) version 26 was used for data entry and analysis. Continuous variables are presented as mean ± SD and categorical variables are presented as frequencies and percentages. An independent sample t-test was used to compare two means. Two-by-two tables were used to measure the validity findings of US in comparison to histopathology. In all statistical analyses, the level of significance was $p < 0.05$ and 95% CI.

Results.

This study included 60 women with breast NMLs who presented with a mean age of (51.4 years); 11.7% of women were aged group of less than 40 years, 30% were age group – 40-49 years, 40% were age group–50-59 years and 18.3% were aged ≥ 60 years (Table 1).

The breast side of the tumor was right in 38.3% of breast NMLs and left in 61.7%. The most commonly affected site in the breast was the UOQ (76.7%), followed by the UIQ (15%), LIQ (3.3%), retro areolar (3.3%), and LOQ (1.7%) (Table 2).

The distribution of NMLs on breast ultrasound was focal (56.7%), segmental (30%), regional (10%), and linear (3.3%). Architectural distortion was seen on breast US in 41.7% of NMLs, and the NMLs were parallel to the skin in 56.7% of them. The echo pattern of breast tu-

Table №1. Age of women with breast lesions.

Age mean±SD (51.4±10.5 years)	No.	%
<40 years	7	11.7
40-49 years	18	30.0
50-59 years	24	40
≥60 years	11	18.3

Table №2. Clinical characteristics of breast lesions.

Variable		No.	%
Tumor side	Right	23	38.3
	Left	37	61.7
Site	UOQ	46	76.7
	LOQ	1	1.7
	UIQ	9	15.0
	LIQ	2	3.3
	Retro areolar	2	3.3

mors was mainly mixed (48.4%), followed by iso-(25%), hypo-(23.3%), and hyper-(3.3%). More than half of breast NMLs contain echogenic dots on breast US, and 60% of them have increased vascularity. Small cystic changes were present in 30% of the NMLs and posterior shadowing in 20% of the cases (Table 3).

Breast NMLs were classified as BI-RADS 4A (35%), BIRADS 4B (51.7%), and 4C (13.3%) (Table 4).

The corresponding mammographic findings of NMLs showed focal asymmetry in 75% of lesions, architectural distortion in 31.7%, and microcalcification in 51.7% (Table 5).

Histopathological examination revealed that 40% of the NMLs were malignant, 15% were BUP, and 45% were benign. The most common malignant breast non-mass tumor was ductal carcinoma in situ (66.6%), followed by invasive ductal carcinoma (16.7%), and invasive lobular carcinoma (16.7%). BUP non-mass breast lesions were commonly atypical ductal hyperplasia (66.7%), followed by intraductal papilloma with atypia (11.1%), atypical lobular hyperplasia (11.1%), and radial scarring (11.1%). The most common benign breast NMLs were fibroadenosis (51.9%), followed by fibrocystic changes (22.2%) (Table 6).

There was a significant association between older age and malignant breast NMLs (p=0.03; 95%CL:2.67-5.13) (Table 7).

There was a significant association between the UIQ site of the breast NML and malignancy (p=0.007) (Table 8).

A highly significant association was observed between segmental breast NML and malignancy (P <0.001). There was a significant association between the presence of architectural distortion and breast NML and malignancy (p=0.02). A significant association was observed between echogenic dots of breast NML and malignancy (p=0.03). There was a highly significant association between intralesional vascularity of the breast NML and malignancy (p<0.001). A highly significant association was observed between small cystic changes in the breast NML and benign tumors (p<0.001). A highly significant association was observed between posterior shadowing of the breast NML and malignancy (p<0.001). No significant differences were observed between the histopathological findings of breast non-mass tumors in terms of orientation and echogenicity (p>0.05) (Table 9).

There was a significant association between advanced BI-RADS for breast NMLs and malignancy (p=0.001); 14.3% of patients with BI-RADS 4A had malignant breast lesions, while 41.9% of patients with BI-RADS 4 B had malignancy and all patients with BI-RADS 4c had malignancy (Table 10).

Figure 1 showed a 35-year-old female with a strong family history of breast cancer who presented for follow-up imaging of previously noted, probably benign findings. Given the ultrasound and mammographic findings, the case was classified as BI-RADS IV, indicating a suspicious abnormality, for which a tissue diagnosis is recommended.

Table №3. Ultrasound characteristics of breast lesions.

Variable		No.	%
Distribution	Regional	6	10.0
	Segmental	18	30.0
	Focal	34	56.7
	Linear	2	3.3
Architectural distortion	Yes	25	41.7
	No	35	58.3
Orientation	Parallel	34	56.7
	Anti-parallel	26	43.3
Echo pattern	Iso-echoic	15	25.0
	Hyper-echoic	2	3.3
	Hypo-echoic	14	23.3
	Mixed	29	48.4
Echogenic dots (microcalcification)	Seen	33	55.0
	Not seen	27	45.0
Vascularity	Yes	36	60.0
	No	24	40.0
Small Cystic changes	Yes	18	30.0
	No	42	70.0
Posterior shadowing	Yes	12	20.0
	No	48	80.0

Table №4. US/BIRADS of women with NMLs.

BIRADS	No.	%
Iva (4A)	21	35.0
IVb (4B)	31	51.7
IVc (4C)	8	13.3

Table №5. Mammography findings of women with NMLs.

Findings		No.	%
Focal asymmetry	Yes	45	75.0
	No	15	25.0
Architectural distortion	Yes	19	31.7
	No	41	68.3
Microcalcification	Seen	31	51.7
	Not seen	29	48.3

Table №6. Final histopathological diagnosis of breast non-mass lesions.

Variable		No.	%
Histopathology	Malignant	24	40.0
	BUP	9	15.0
	Benign	27	45.0
Malignant tumors	Invasive ductal carcinoma	4	16.7
	Invasive lobular carcinoma	4	16.7
	DCIS	16	66.6
BUP	Atypical ductal hyperplasia	6	66.7
	Atypical lobular hyperplasia	1	11.1
	Intraductal papilloma with atypia	1	11.1
	Radial scar	1	11.1
Benign tumors	Fibroadenosis	14	51.9
	Fibroadenosis with usual ductal hyperplasia	3	11.1
	Fibrocystic changes	6	22.2
	Fat necrosis	1	3.7
	Fibrosis (some with focal ductal adenosis)	3	11.1

Table №7. Distribution of age groups according to histopathology diagnosis.

Age (years)	Histopathology						P-value (95%CI)
	Malignant		BUP		Benign		
	No.	%	No.	%	No.	%	
<40	2	28.6	2	28.6	3	42.9	0.03 (2.67-5.13)
40-49	6	33.3	1	5.6	11	61.1	
50-59	7	29.2	6	25.0	11	45.8	
≥60	9	81.8	0	-	2	18.2	

Table №8. Distribution of side and site of NMLs according to histopathology diagnosis.

Variable		Histopathology						P-value (95%CI)
		Malignant		BUP		Benign		
		No.	%	No.	%	No.	%	
Side	Right	10	43.5	4	17.4	9	39.1	0.7 (0.16-1.58)
	Left	14	37.8	5	13.5	18	48.6	
Site	UOQ	15	32.6	9	19.6	22	47.8	0.007 (4.52-11.33)
	LOQ	0	-	0	-	1	100.0	
	UIQ	9	100.0	0	-	0	-	
	LIQ	0	-	0	-	2	100.0	
	Retro	0	-	0	-	2	100.0	

Table №9. Distribution of ultrasound characteristics according to histopathology diagnosis.

Variable		Histopathology						P-value (95%CI)
		Malignant		BUP		Benign		
		No.	%	No.	%	No.	%	
Distribution	Regional	1	16.7	3	50.0	2	33.3	**<0.001** (4.37-20.45)
	Segmental	14	77.8	3	16.7	1	5.6	
	Focal	9	26.5	3	8.8	22	64.7	
	Linear	2	100.0	0	-	0	-	
Architectural distortion	Yes	14	56.0	5	20.0	6	24.0	**0.02** (3.77-7.52)
	No	10	28.6	4	11.4	21	60.0	
Orientation	Parallel	15	44.1	4	11.8	15	44.1	0.6 (0.99-1.05)
	Anti-parallel	9	34.6	5	19.2	12	46.2	
Echo pattern	Iso-echoic	5	33.3	2	13.3	8	53.3	0.1 (1.02-1.69)
	Hyper-echoic	0	-	0	-	2	100.0	
	Hypo-echoic	6	42.9	5	35.7	3	21.4	
	Mixed	13	44.8	2	6.9	14	48.3	
Microcalcification	Seen	18	54.5	4	12.1	11	33.3	**0.03** (2.38-8.05)
	Not seen	6	22.2	5	18.5	16	59.3	
Vascularity	Yes	21	58.3	6	16.7	9	25.0	**<0.001** (5.66-19.48)
	No	3	12.5	3	12.5	18	75.0	
Cystic changes	Yes	2	11.1	0	-	16	88.9	**<0.001** (2.68-6.77)
	No	22	52.4	9	21.4	11	26.2	
Posterior shadowing	Yes	12	100.0	0	-	0	-	**<0.001** (5.98-12.46)
	No	12	25.0	9	18.8	27	56.3	

Table №10. Distribution of BIRADS according to histopathology diagnosis.

US/BIRADS	Histopathology						P-value (95%CI)
	Malignant		BUP		Benign		
	No.	%	No.	%	No.	%	
IVa	3	14.3	3	14.3	15	71.4	**<0.001 (3.56-14.57)**
IVb	13	41.9	6	19.4	12	38.7	
IVc	8	100.0	0	-	0	-	

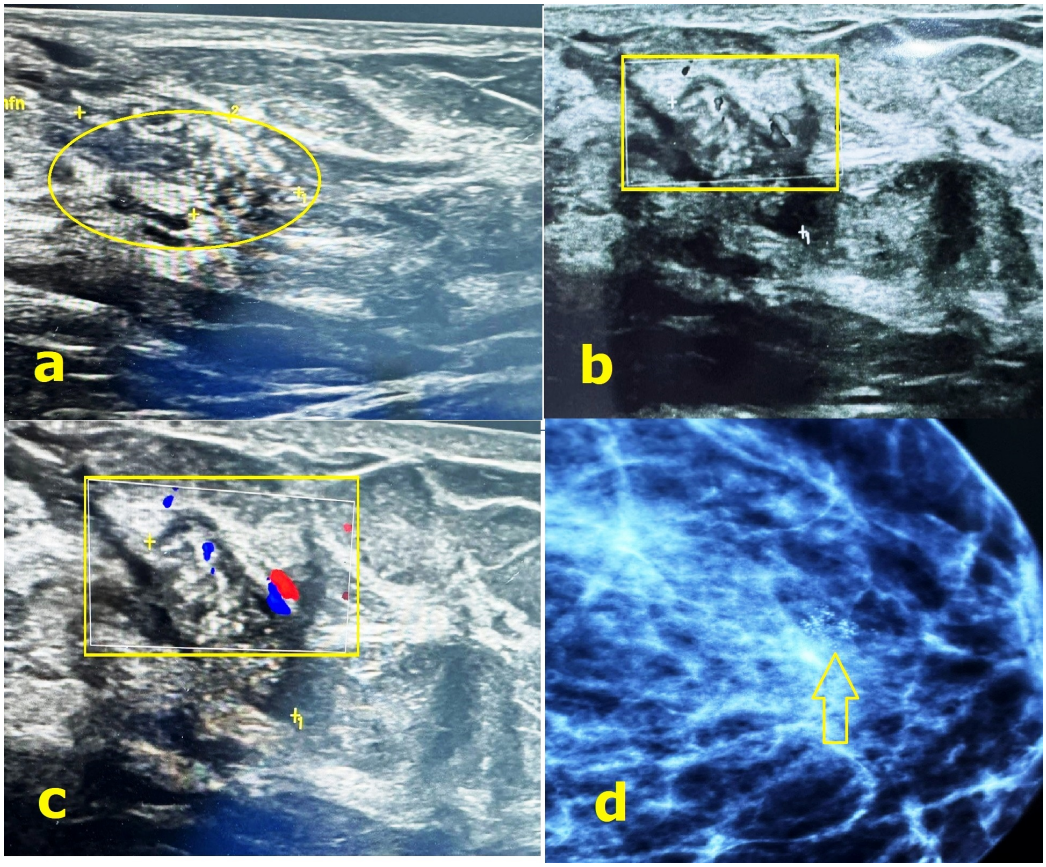

Fig. 1 (Рис. 1)

Fig. 1. a, b, c – Ultrasound; d – Mammography. A 35-year-old female with a strong family history of breast cancer presents for follow-up imaging of previously noted probably benign findings.

a, b, c – Ultrasound of the left breast reveals a focal non-mass area with heterogeneous echotexture measuring approximately 16×8 mm at the 3 o'clock position, 1.5 cm from the nipple. This area contains echogenic foci suggestive of microcalcifications and demonstrates internal vascularity on Doppler evaluation, raising suspicion for malignancy. Additionally, a small, well-circumscribed oval hypoechoic lesion measuring 7×3 mm is identified at the 4 o'clock position, 3 cm from the nipple, consistent with a likely benign fibroadenoma. The nipple, areola, skin, and regional lymph nodes appear normal.

d – Mammography confirms the presence of microcalcifications in the region of concern. Given the ultrasound and mammographic findings, the case is classified as BIRADS IV, indicating a suspicious abnormality for which a tissue diagnosis is recommended. Biopsy of the suspicious area is advised, and further evaluation, including genetic counseling, may be warranted considering the patient's strong family history. .

Рис. 1. a, b, c – УЗИ; d – Маммография. Пациентка, 35 лет, с отягощённым семейным анамнезом по раку молочной железы, направлена на контрольное исследование в связи с ранее выявленными, вероятно, доброкачественными изменениями.

a, b, c – При ультразвуковом исследовании левой молочной железы в 3 часах условного циферблата, на расстоянии 1,5 см от соска, определяется фокусное неопухолеподобное образование с гетерогенной эхоструктурой, размерами около 16×8 мм. Внутри зоны визуализируются эхогенные включения, соответствующие микрокальцинатам, а также внутрипоражённая васкуляризация по данным допплеровского картирования, что повышает вероятность злокачественного процесса. Дополнительно в 4 часах условного циферблата, на расстоянии 3 см от соска, выявлено небольшое овальное гипоэхогенное образование с чёткими контурами, размерами 7×3 мм, соответствующее, вероятно, фиброаденоме. Сосок, область ареолы, кожа и регионарные лимфатические узлы без особенностей.

d – Маммография подтвердила наличие микрокальцинатов в зоне интереса. Учитывая совокупность ультразвуковых и маммографических данных, случай классифицирован как BI-RADS 4 – подозрительное образование, требующее морфологической верификации. Рекомендовано проведение биопсии подозрительного участка, а с учётом семейного анамнеза – дополнительная генетическая консультация.

A significant association was observed between the corresponding focal asymmetry of the breast NML and malignancy (p=0.001). There was a highly significant association between architectural distortion and malignancy (p<0.001). A significant association was observed between microcalcifications of breast NML and malignancy (p=0.008) (Table 11).

Figure 2 a 32-year-old female presents with a suspicious lesion in the left breast. Ultrasound reveals a segmental, non-mass area of heterogeneous echotexture. Histopathological examination confirms the diagnosis of IDC.

After considering the BUP as malignant (because there is usually a risk of upgrading to malignancy on larger biopsy and the management of these lesions either by surgical excision or vacuum-assisted excision (VAE)), there was a significant association between malignant findings on ultrasound and histopathology (p=0.003), with validity findings of US for diagnosis of malignant NMLs in comparison to histopathology (sensitivity 81.8%, specificity 55.6%, PPV 69.2%, NPV 71.4%, and accuracy 70%) (Table 12).

Table №11. Distribution of mammography findings according to histopathology diagnosis.

Variable		Histopathology						P-value (95%CI)
		Malignant		BUP		Benign		
		No.	%	No.	%	No.	%	
Focal asymmetry	Yes	24	53.3	6	13.3	15	33.3	**0.001**
	No	0	-	3	20.0	12	80.0	
Architectural distortion	Yes	17	89.5	0	-	2	10.5	**<0.001**
	No	7	17.1	9	22.0	25	61.0	
Microcalcification	Seen	18	58.1	2	6.5	11	35.5	**0.008**
	Not seen	6	20.7	7	24.1	16	55.2	

Table №12. Association between BIRADS 4 classification and final histopathological diagnosis.

Variable		Histopathology		P-value (95%CI)
		Malignant	Benign	
		No. (%)	No. (%)	
BIRADS	4 B & C	27 (81.8)	12 (44.4)	**0.003**
	4 A	6 (18.2)	15 (55.6)	(4.88-12.63)
Sensitivity		81.8%		
Specificity		55.6%		
PPV		69.2%		
NPV		71.4%		
Accuracy		70%		

Discussion.

Ultrasonography is useful for screening both breast masses and NMLs. Ultrasound BI-RADS is essential for the categorization of breast mass lesions. Assessing the reliability of ultrasound BI-RADS in breast NMLs is important in prioritizing invasive investigations and directions for earlier management [48]. However, some authors have revealed a difficulty in using ultrasound BI-RADS 4A to 4C in screening of breast cancers as they are highly suspicious and end with biopsy [5].

The current study found that the ultrasound BI-RADS of breast NMLs was greater than that of BI-RADS 4 B. These findings are different from the results of Xu et al. in China, who reported ultrasound BI-RADS of breast NMLs as BI-RADS 4A (47.06%) [6]. These differences might be related to differences in the risk factors of breast non-mass and the time of diagnosis between different studies. A recent Iraqi study documented the importance of ultrasound BI-RADS 4 subcategorization in differentiating between malignant and benign breast lesions [7].

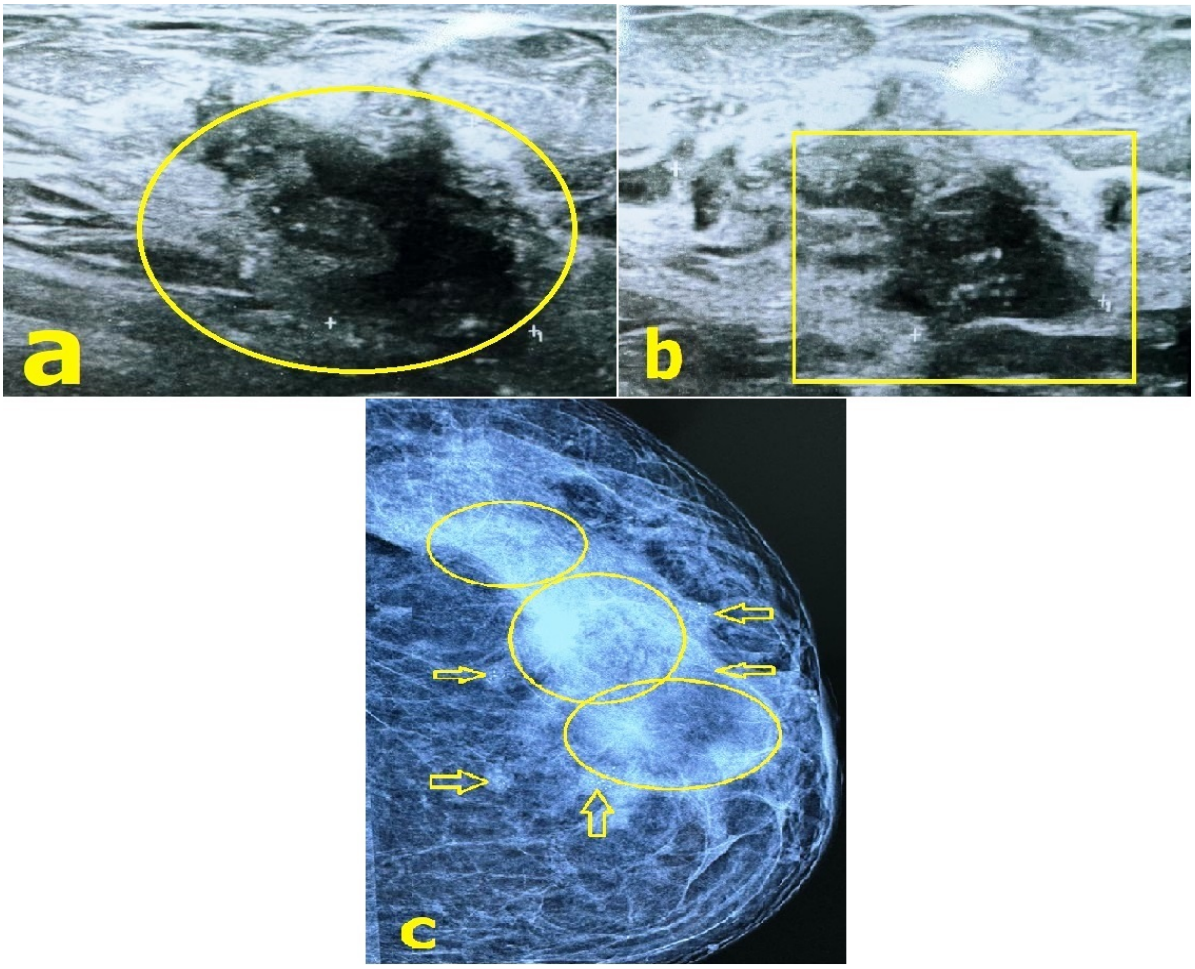

Fig. 2 (Рис. 2)

Fig. 2. a, b – Ultrasound; c – Mammography. A 32-year-old female presents with a suspicious lesion in the left breast.

a, b – Ultrasound reveals a segmental, non-mass area of heterogeneous echotexture measuring approximately 35×18 mm, located at the 2-3 o'clock position, 4 cm from the nipple. Within this area, multiple echogenic foci are observed, suggestive of microcalcifications.

c – Mammography confirms the presence of microcalcifications in the same region. The imaging features are highly suspicious for malignancy.

Histopathological examination following biopsy confirms the diagnosis of invasive ductal carcinoma with associated ductal carcinoma in situ (DCIS). These findings are consistent with a segmental malignant process, and appropriate oncologic management should be initiated.

Рис. 2. a, b – УЗИ; c – Маммография. Пациентка, 32 лет, с подозрительным очагом в левой молочной железе.

a, b – При ультразвуковом исследовании в 2-3 часах условного циферблата, на расстоянии 4 см от соска, определяется сегментарная немассоподобная зона с гетерогенной эхоструктурой, размерами около 35×18 мм. Внутри зоны визуализируются множественные эхогенные включения, соответствующие микрокальцинатам.

c – Маммография подтвердила наличие микрокальцинатов в данной области. Совокупность полученных данных расценена как высокая вероятность злокачественного процесса.

По результатам гистопатологического исследования после биопсии установлен диагноз инвазивной протоковой карциномы с участками протокового рака in situ (DCIS). Эти результаты соответствуют сегментарному злокачественному процессу, что требует назначения соответствующего онкологического лечения.

In the present study, histopathological examination revealed that the majority of NMLs were benign. These findings are inconsistent with the results of recent Hameed and Fareed study, which revealed that 60% of breast NMLs are benign [8]. This inconsistency may be attributed to the fact that our study center is a tertiary center that receives more deteriorated cases from centers in all countries. However, many authors have stated that a high proportion of breast NMLs are benign on histopathology examination [9, 10]. The most common malignant breast NMLs in our study was DCISnon-mass. These findings are in agreement with the results of Kim and Jung, who reported that the main malignant breast non-mass tumor was ductal carcinoma in situ [11].

Our study showed that BUP NMLs commonly present with ADH. This finding is consistent with that reported by Choi et al. in Japan [12]. In our study, the most common benign breast non-mass tumor was fibroadenosis. These findings are similar to those reported by Stachs et al. [13].

The current study showed that the mean age of patients with malignant breast non-mass tumors was middle-aged women. This finding coincides with the results of Zhang et al., who documented a high malignancy risk for NMLs among older women [14]. The common breast non-mass site affected was the UOQ; however, there was a significant association between the UIQ site of breast NML and malignancy (p=0.007). This finding is parallel to the report of Mohan et al. review study in India [15].

Here, the ultrasound characteristics of malignant NMLs were segmental distribution, associated architectural distortion, echogenic dots, increased intralesional vascularity, and posterior shadowing. These findings are consistent with data from different studies, such as Park et al. in South Korea and Guo et al. in China, which documented a significant correlation between architectural distortion, microcalcification, increased vascularity, and posterior shadowing on ultrasound with malignancy of breast NMLs [16, 17].

A highly significant association was observed between small cystic changes in breast US-NML and benign tumors. Consistently, Tsunoda and Moon from South Korea reported that US findings of cystic changes were predictive of benign breast NML [1].

Advanced Breast Imaging Reporting and BIRADS for breast NMLs related to malignancy. This finding is consistent with the results of Örgüç et al., who found that the BI-RADS for breast NMLs was significantly related to histopathological findings [18].

BI-RADS 4A, 4 B, and 4C are malignancies in different proportions. These findings are similar to those of Xie and Zhang, who stated that the malignancy risk in breast NMLs was 6.25% for BI-RADS 4A, 26.13% for BI-RADS 4 B, and 80.84% for BI-RADS 4C [19]. On the other hand, some authors reported a limitation in BI-RADS in the interpretation of breast NMLs, especially regarding echogenicity [20].

The validity of BI-RADS for the diagnosis of malignant NMLs in comparison to histopathology has high sensitivity and moderate specificity. These findings are similar to those of Lin and Wu, who reported that the validity of BI-RADS for the diagnosis of malignant NMLs in comparison to histopathology was (sensitivity 82.98%, specificity 41.67%, and accuracy 65%) [10].

Mammography findings of focal asymmetry, architectural distortion, and microcalcification of breast NML are associated with malignancy. These findings are similar to those of Zhang et al., who reported that the use of both ultrasound and mammography is valuable in the characterization of breast NMLs, and that mammography findings of focal asymmetry, architectural distortion, and microcalcification are highly predictable for malignant lesions [21].

Recently, the authors concluded that multiparametric MRI offers significant advantages for diagnosing breast cancer in women with dense breast tissues. The integration of MRI with standard mammography facilitates a more effective approach for early detection and treatment planning [22]. The results of the study by Reshetov et al. should be considered when evaluating US data in women after combined mammoplasty to avoid false interpretation of the results [23]. It is essential to consider this indicator of breast atrophy in the postoperative period, as the use of implants does not lead to the development of proliferative processes. Gazonova et al. recently recommended the use of elastography, micro-flow, and echo-contrast methods to improve the accuracy of the differential diagnosis of breast tumors in BI-RADS (III-IV) [24]. Thus, future studies should focus on refining these techniques and enhancing their clinical application to improve outcomes in patients with breast cancer.

It is important to acknowledge that the BI-RADS lexicon, particularly for ultrasound, does not formally define non-mass lesions (NMLs) as a distinct category. The application of BI-RADS 4 subcategories (4A, 4 B, and 4C) to NMLs, as done in this study, is based on clinical extrapolation and radiologic interpretation of suspicious features commonly associated with malignancy (e.g., architectural distortion, vascularity, and microcalcifications), rather than on standardized criteria defined by BI-RADS. This repre-

sents a methodological limitation of this study. Although categorization using BI-RADS 4 subgroups helps stratify malignancy risk and guide biopsy decisions, the lack of a formal definition and standardized descriptors for NMLs in the BI-RADS lexicon may lead to variability in interpretation among radiologists and between institutions. Therefore, the findings related to BI-RADS-based risk stratification of NMLs in this study should be interpreted with caution in the context of existing diagnostic challenges. Future research and updates to the BI-RADS lexicon may consider incorporating clear criteria or a framework for classifying non-mass lesions given their growing clinical relevance.

Conclusions.

Ultrasonography is helpful for the characterization of breast NMLs. The ultrasound BI-RADS has higher sensitivity and low specificity in the categorization of breast NMLs. BI-RADS 4C is associated with a higher risk of malignant breast NML. Ultrasound characteristics of segmental distribution, associated architectural distortion, echogenic dots, increased vascularity, and posterior shadowing are predictive of malignant breast NMLs, whereas cystic changes on ultrasound are predictive of benign breast NMLs. Mammography findings are useful for further characterization of breast NMLs on US. A high probability of malignancy in the presence of imaging correlates with mammography findings.

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Conflicts of interest.

The authors declare no conflict of interest regarding this article.

References:

1. Tsunoda H, Moon WK. Beyond BI-RADS: Nonmass Abnormalities on Breast Ultrasound. Korean J Radiol 2024; 25(2):134-145.

2. Choe J, Chikarmane SA, Giess CS. Nonmass Findings at Breast US: Definition, Classifications, and Differential Diagnosis. Radiographics 2020; 40:326–335.

3. Park KW, Park S, Shon I, Kim MJ, Han BK, Ko EY, et al. NMLs detected by breast US: stratification of cancer risk for clinical management. Eur Radiol 2021; 31:1693-1706.

4. Hille H, Vetter M, Hackelöer BJ. The accuracy of BI-RADS classification of breast ultrasound as a first-line imaging method. Ultraschall Med 2012; 33:160-163.

5. Spinelli Varella MA, Teixeira da Cruz J, Rauber A, Varella IS, Fleck JF, Moreira LF. Role of BI-RADS Ultrasound Subcategories 4A to 4C in Predicting Breast Cancer. Clin Breast Cancer 2018; 18(4):e507-e511.

6. Xu P, Yang M, Liu Y, Li YP, Zhang H, Shao GR. Breast non-mass-like lesions on contrast-enhanced ultrasonography: Feature analysis, breast image reporting and data system classification assessment. World J Clin Cases 2020; 8(4):700-712.

7. Abdulwahid HM, Yahya ZM, Nidhal F, AL Zahwi FAJ, Ali MJ. Correlation between ultrasound BI-RADS 4 breast lesions and fine needle cytology categories in a sample of Iraqi female patients. Eabr 2023; 24(4):297-304.

8. Hameed HJ, Fareed SBA. Correlation of NMLs on ultrasound with histopathology. American Journal of Diagnostic Imaging 2024; 11(1): 1-8.

9. Yamaguchi R, Watanabe H, Mihara Y, Yamaguchi M, Tanaka M. Histopathology of non-mass-like breast lesions on ultrasound. J Med Ultrason (2001) 2023; 50(3):375-380.

10. Lin M, Wu S. Ultrasound classification of NMLs following BI-RADS presents high positive predictive value. PLoS ONE 2022; 17(11): e0278299. Available from: https://doi.org/10.1371/journal.pone.0278299

11. Kim HR, Jung HK. Histopathology findings of non-mass cancers on breast ultrasound. Acta Radiol Open 2018; 7(6):2058460118774957.

12. Choi JS, Tsunoda H, Moon WK. Nonmass Lesions on Breast US: An International Perspective on Clinical Use and Outcomes. J Breast Imaging 2024; 6(1):86-98.

13. Stachs A, Stubert J, Reimer T, Hartmann S. Benign Breast Disease in Women. Dtsch Arztebl Int 2019; 116(33-34):565-574.

14. Zhang F, Li G, Jin L, Jia C, Shi Q, Wu R. Diagnostic value of Doppler imaging for malignant NMLs: with different diagnostic criteria for older and younger women: first results. Clinical Hemorheology and Microcirculation 2022; 81(2):123-134.

15. Ko KH, Hsu HH, Yu JC. Non-mass-like breast lesions at ultrasonography: feature analysis and BI-RADS assessment. Eur J Radiol 2015; 84(01):77–85.

16. Park JW, Ko KH, Kim E-K, Kuzmiak CM, Jung HK. NMLs on ultrasound: final outcomes and predictors of malignancy. Acta Radiologica 2017; 58(9):1054-1060.

17. Guo W, Wang T, Li F, Jia C, Zheng S, Zhang X, et al. NMLs: Could Multimodal Ultrasound Imaging Be Helpful for Their Diagnosis? Diagnostics (Basel) 2022; 12(12):2923.

18. Örgüç Ş, Açar ÇR. Non-mass Findings on Breast Ultrasonography and Differential Diagnosis. Turk Radiol Semin 2023; 11(3):297-311.

19. Xie Y, Zhang X. A risk prediction stratification for NMLs, combining clinical characteristics and imaging features on ultrasound, mammography, and MRI. Front. Oncol 2024; 14:1337265.

20. Uematsu T. NMLs on breast ultrasound: why does not the ACR BI-RADS breast ultrasound lexicon add the terminology? J Med Ultrason 2023; 50(03):341–346.

21. Mendelson E B, Böhm-Vélez M, Berg W A, Whitman G J, Feldman M I, Madjar H.Acr bi-rads® ultrasound. ACR BI-RADS® atlas, breast imaging reporting and data system 2013; 149.

22. Labidi A., Alizada E.E., Bakhtiozin R.F. The role of multiparametric MRI in diagnosing breast cancer in patients with dense breast tissue. REJR. 2025; 15(1):177-192. DOI: 10.21569/2222-7415-2025-15-1-177-192 (in Russian).

23. Reshetov I.V., Faizullin T.R., Aleksanyan T.A. Results of dynamic ultrasonographic study in patients after combined

mammoplasty. REJR. 2025; 15(2):65-72. DOI: 10.21569/2222-7415- 2025-15-2-65-72 (in Russian).

24. Gazonova V.E., Zubarev A.V., Pulatova I.Z. Innovative approaches in the diagnosis of focal breast lesions BI-RADS 3-4: role and prospects of integrating contrast-enhanced ultrasound and elastography. REJR. 2025; 15(1):107-118. DOI: 10.21569/2222-7415-2025-15-1-107-118 (in Russian).

Список литературы:

1. Tsunoda H, Moon WK. Beyond BI-RADS: Nonmass Abnormalities on Breast Ultrasound. Korean J Radiol 2024; 25(2):134-145.

2. Choe J, Chikarmane SA, Giess CS. Nonmass Findings at Breast US: Definition, Classifications, and Differential Diagnosis. Radiographics 2020; 40:326–335.

3. Park KW, Park S, Shon I, Kim MJ, Han BK, Ko EY, et al. NMLs detected by breast US: stratification of cancer risk for clinical management. Eur Radiol 2021; 31:1693-1706.

4. Hille H, Vetter M, Hackelöer BJ. The accuracy of BI-RADS classification of breast ultrasound as a first-line imaging method. Ultraschall Med 2012; 33:160-163.

5. Spinelli Varella MA, Teixeira da Cruz J, Rauber A, Varella IS, Fleck JF, Moreira LF. Role of BI-RADS Ultrasound Subcategories 4A to 4C in Predicting Breast Cancer. Clin Breast Cancer 2018; 18(4):e507-e511.

6. Xu P, Yang M, Liu Y, Li YP, Zhang H, Shao GR. Breast non-mass-like lesions on contrast-enhanced ultrasonography: Feature analysis, breast image reporting and data system classification assessment. World J Clin Cases 2020; 8(4):700-712.

7. Abdulwahid HM, Yahya ZM, Nidhal F, AL Zahwi FAJ, Ali MJ. Correlation between ultrasound BI-RADS 4 breast lesions and fine needle cytology categories in a sample of Iraqi female patients. Eabr 2023; 24(4):297-304.

8. Hameed HJ, Fareed SBA. Correlation of NMLs on ultrasound with histopathology. American Journal of Diagnostic Imaging 2024; 11(1): 1-8.

9. Yamaguchi R, Watanabe H, Mihara Y, Yamaguchi M, Tanaka M. Histopathology of non-mass-like breast lesions on ultrasound. J Med Ultrason (2001) 2023; 50(3):375-380.

10. Lin M, Wu S. Ultrasound classification of NMLs following BI-RADS presents high positive predictive value. PLoS ONE 2022; 17(11): e0278299. Available from: https://doi.org/10.1371/journal.pone.0278299

11. Kim HR, Jung HK. Histopathology findings of non-mass cancers on breast ultrasound. Acta Radiol Open 2018; 7(6):2058460118774957.

12. Choi JS, Tsunoda H, Moon WK. Nonmass Lesions on Breast US: An International Perspective on Clinical Use and Outcomes. J Breast Imaging 2024; 6(1):86-98.

13. Stachs A, Stubert J, Reimer T, Hartmann S. Benign Breast Disease in Women. Dtsch Arztebl Int 2019; 116(33-34):565-574.

14. Zhang F, Li G, Jin L, Jia C, Shi Q, Wu R. Diagnostic value of Doppler imaging for malignant NMLs: with different diagnostic criteria for older and younger women: first results. Clinical Hemorheology and Microcirculation 2022; 81(2):123-134.

15. Ko KH, Hsu HH, Yu JC. Non-mass-like breast lesions at ultrasonography: feature analysis and BI-RADS assessment. Eur J Radiol 2015; 84(01):77–85.

16. Park JW, Ko KH, Kim E-K, Kuzmiak CM, Jung HK. NMLs on ultrasound: final outcomes and predictors of malignancy. Acta Radiologica 2017; 58(9):1054-1060.

17. Guo W, Wang T, Li F, Jia C, Zheng S, Zhang X, et al. NMLs: Could Multimodal Ultrasound Imaging Be Helpful for Their Diagnosis? Diagnostics (Basel) 2022; 12(12):2923.

18. Örgüç Ş, Açar ÇR. Non-mass Findings on Breast Ultrasonography and Differential Diagnosis. Turk Radiol Semin 2023; 11(3):297-311.

19. Xie Y, Zhang X. A risk prediction stratification for NMLs, combining clinical characteristics and imaging features on ultrasound, mammography, and MRI. Front. Oncol 2024; 14:1337265.

20. Uematsu T. NMLs on breast ultrasound: why does not the ACR BI-RADS breast ultrasound lexicon add the terminology? J Med Ultrason 2023; 50(03):341–346.

21. Mendelson E B, Böhm-Vélez M, Berg W A, Whitman G J, Feldman M I, Madjar H.Acr bi-rads® ultrasound. ACR BI-RADS® atlas, breast imaging reporting and data system 2013; 149.

22. Лабиди А., Ализада Э.Э., Бахтиозин Р.Ф. Роль мультипараметрической МРТ в диагностике рака молочной железы у пациенток с плотной железистой тканью. REJR. 2025; 15(1):177-192. DOI: 10.21569/2222-7415-2025-15-1-177-192.

23. Решетов И.В., Файзуллин Т.Р., Алексанян Т.А. Результаты динамического ультразвукового исследования пациентов после комбинированной маммопластики. REJR. 2025; 15(2):65-72. DOI: 10.21569/2222-7415-2025-15-2-65-72.

24. Гажонова В.Е., Зубарев А.В., Пулатова И.З. Инновационные подходы в диагностике очаговых образований молочной железы категории BI-RADS 3-4: роль и перспективы интеграции ультразвукового исследования с контрастированием и эластографии. REJR. 2025; 15(1):107-118. DOI: 10.21569/2222-7415-2025-15-1-107-118.