NON MASS LESIONS IN BREAST ULTRASOUND

Dr. Behnaz Moradi, M.D

Associate professor of radiology

TUMS, YAS General Hospital

INTRODUCTION

- The term nonmass finding is not included in the current Breast Imaging Reporting and Data System (BI-RADS) US lexicon
- with the development of high-resolution US, we have increasingly found NMLs that do not adhere to the definition of “mass”
- **a sonographic finding that does not conform to a mass shape (ie, nonconvex borders)**
- incidence of nonmass findings at screening US: 1.0%–5.3% (in recent studies up to 9%)
- In addition, US correlates for mammographic abnormalities, such as developing and focal asymmetries and nonmass enhancement at MRI, may manifest as nonmass findings
- Owing to the lack of unified terminology describing these US findings, nonmass findings have been described using a variety of terms and phrases in the literature
- More important, a wide range of benign and malignant pathologic conditions appear as nonmass findings

NO WIDELY ACCEPTED CLASSIFICATION SYSTEM FOR NONMASS FINDINGS

Kim et al (2)	Nonmass finding patterns: Mottled: a number of small hypoechoic islands of tissue Geographic: confluent hypoechoic areas without a cobblestone appearance that resemble geographic maps Indistinct: relatively uniform hypoechoic areas without clearly defined margins Nonmass distributions: Focal distribution: involving less than one quadrant of the breast Regional distribution: involving more than one quadrant of the breast
Giess et al (4)	Nonmass finding echotexture was categorized as predominantly (>50%) hypoechoic, predominantly hyperechoic, mixed hyperechoic and hypoechoic, or predominantly anechoic Associated findings: echogenic halo, shadowing, calcifications, architectural distortion, or ductal or tubular architecture
Park et al (8)	Distribution of nonmass findings: Focal: small confined area Linear-segmental: longitudinal or triangular area arrayed in a line or along the branches involving one or more ducts Regional: large geographic area of tissue that does not conform to a ductal or segmental distribution Associated features: calcifications, architectural distortion, and abnormal ductal changes
Wang et al (10)	Nonmass findings were classified as: Hypoechoic area (an area with low-level echoes) Hypoechoic area with sporadic or scattered microcalcifications Architectural distortion (an area with disordered organization structure compared to that of normal tissue) Solid echogenicity within a duct (solid lesion within a duct)
Ko et al (12)	Nonmass findings were classified into four types: Type 1: ductal hypoechoic area with ductal structures and parallel orientation, with and without calcifications Type 2: nonductal hypoechoic area visible as a confined asymmetry with an indistinct shape on two different projections, with and without calcifications Type 3: vague area of altered echotexture with associated architectural distortion Type 4: indistinct hypoechoic area with associated posterior acoustic shadowing
Japan Association of Breast and Thyroid Sonology (13)	Nonmass findings were classified as: Ductal dilatation Multivesicular pattern Low-echo area in the mammary gland (spotted or mottled low-echo areas, geographic low-echo areas, or low-echo areas with indistinct margins) Architectural distortion
Uematsu (14)	Nonmass findings were classified as: Ductal hypoechoic area: ductlike structure with parallel orientation Single ductal hypoechoic area Multiple ductal hypoechoic areas Nonductal hypoechoic area: an area with an indistinct shape at different projections but lacking convex outer borders and conspicuity Focal nonductal hypoechoic area: a nonoriented hypoechoic area occupying a volume of less than one quadrant of the breast Segmental nonductal hypoechoic area: a triangular or cone-shaped hypoechoic area with the apex pointing to the nipple Associated findings: calcifications and architectural distortion Multiple, bilateral, and diffuse hypoechoic areas are considered normal variations or changes caused by hormonal influences unless there is a corresponding palpable abnormality

US FEATURES OF NONMASS FINDINGS

It useful to categorize nonmass findings by echogenicity and distribution

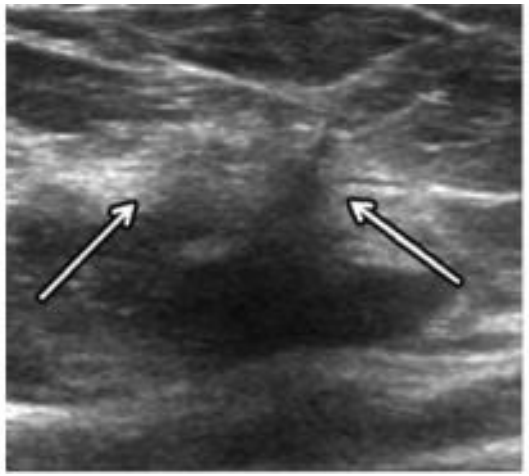
- Predominantly (>50%) hypoechoic
- Predominantly hyperechoic
- Mixed hyperechoic and hypoechoic
- Predominantly anechoic

- Focal (small confined area)
- Linear-segmental
- (longitudinal or triangular area, ductal)
- Regional (a large geographic area)

Associated features

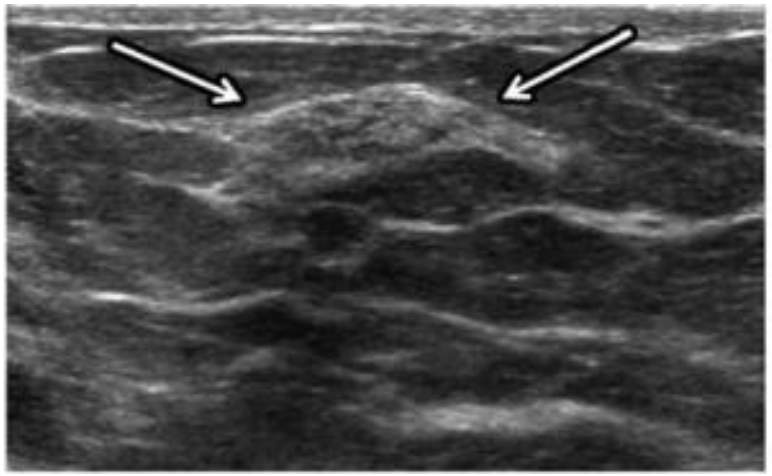
- Tubular or ductal architecture
- Posterior shadowing
- Architectural distortion
- Calcifications

Echogenicity



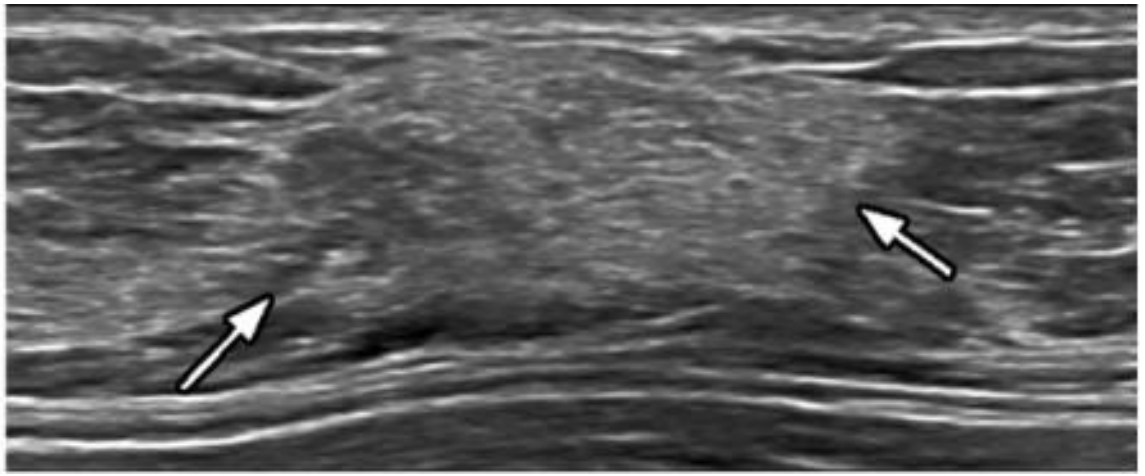
Hypoechoic nonmass

Architectural distortion at mammography
complex sclerosing lesion



Mixed echogenic nonmass

a focal asymmetry in mammo
epithelial hyperplasia and PASH



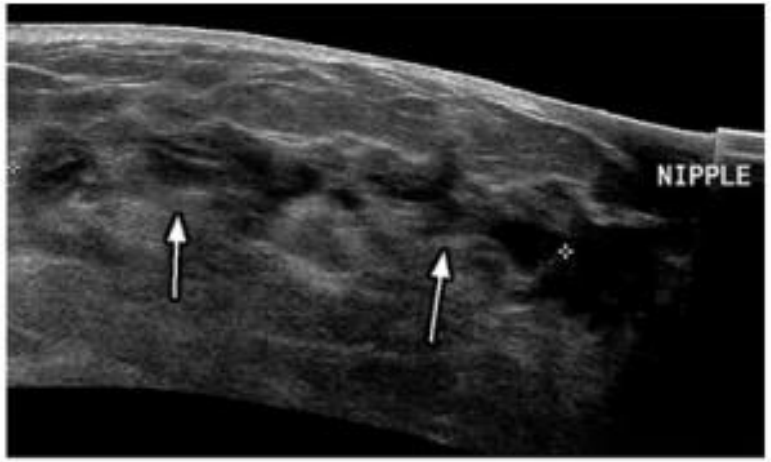
Hyperechoic nonmass

a palpable concern in the right breast and a negative diagnostic mammogram
fibroadenomatous changes and PASH

Distribution

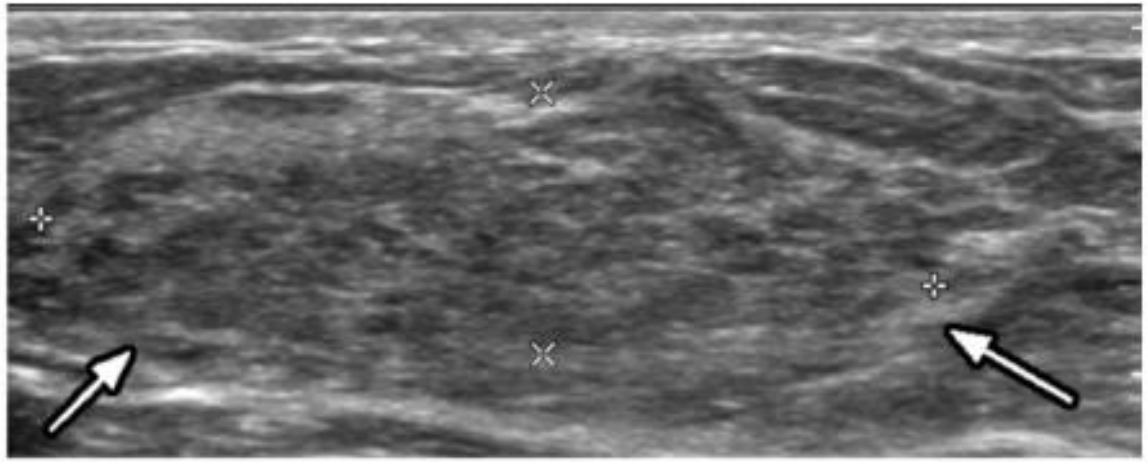
focal distribution

Architectural distortion in mammo
radial sclerosing lesion +UDH



linear-segmental distribution

palpable mass, with focal asymmetry and architectural distortion depicted at mammo
CNB: dense stromal fibrosis
Excision: IDC+DCIS



regional distribution

palpable concern in the right breast, with a developing asymmetry depicted at mammo
CNB: fibrous breast tissue
Excision: lobular carcinoma in situ

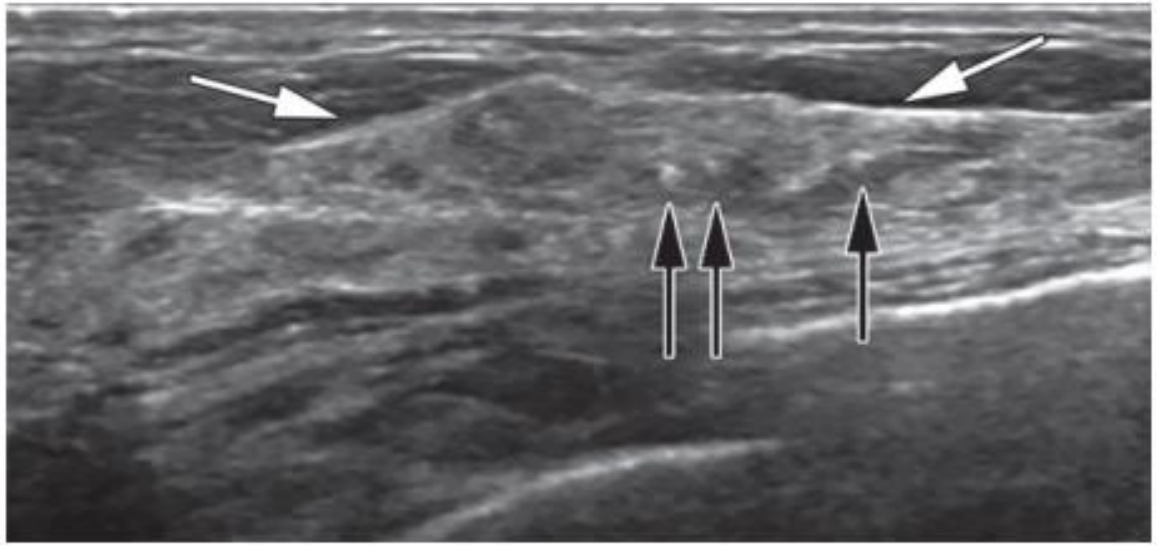
CORRELATIONS WITH HISTOPATHOLOGIC FINDINGS AND BENIGN AND MALIGNANT HISTOLOGIC FINDINGS

- Nonmass findings are benign in 46%– 90% of cases, with malignancy rates for nonmass findings reported in the literature as ranging from 10% to 54%
- The US feature of a nonmass finding consistently associated with malignancy is the presence of associated calcifications
- Calcifications depicted on US images have been reported to be more than three times more likely to be malignant than those that were not depicted
- Architectural distortion is a more frequent associated feature of nonmass findings in malignant lesions than in benign lesions
- Other associated features (ductal distribution &osterior acoustic shadowing) can be seen in both benign and malignant pathologies.
- The malignancy rate by echotexture of nonmass findings is not known
- linear-segmental distribution was more commonly depicted in malignant nonmass findings than in benign lesions

Associated Feature	Histopathologic Entities
Calcifications	IDC, DCIS, atypical ductal hyperplasia, lobular carcinoma in situ, fibroadenoma, radial scar, and tubular adenoma
Ductal or tubular architecture	IDC, DCIS, intraductal papilloma, atypical ductal hyperplasia, atypical lobular hyperplasia, fibrocystic changes, and ductal ectasia
Posterior acoustic shadowing	Invasive carcinoma, postoperative scar, complex sclerosing lesion, and fibrous or dense breast tissue
Architectural distortion	Invasive carcinoma, DCIS, fibrosis, sclerosing adenosis, fat necrosis, and radial scar and/or complex sclerosing lesion

Benign and malignant pathologies

Associated findings

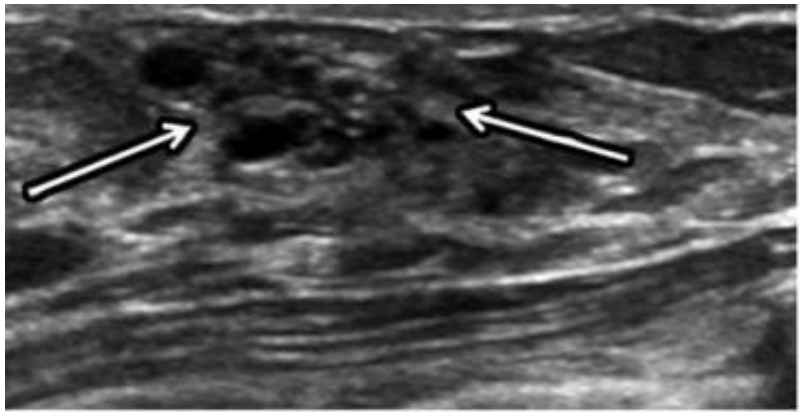


calcifications

at the area of mammographic fine pleomorphic and linear-branching calcifications

CNB: atypical apocrine proliferation

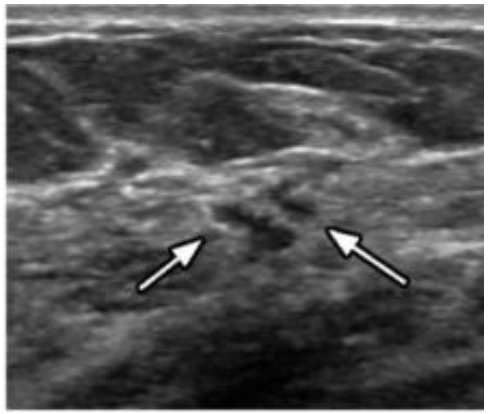
Excision: DCIS



a palpable concern

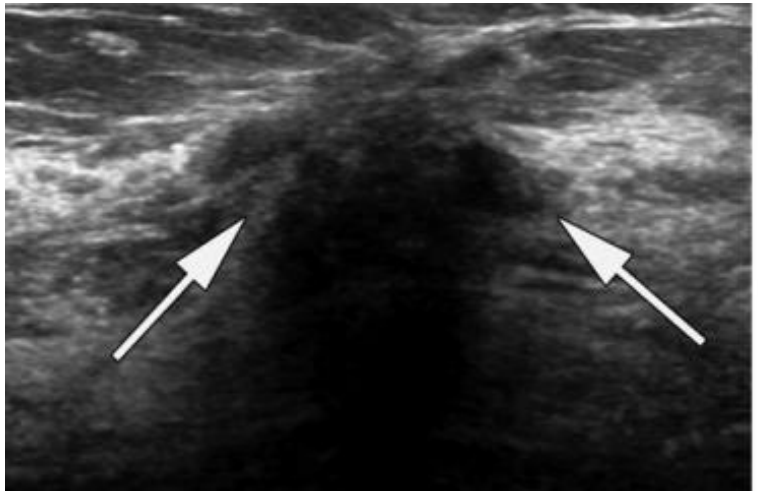
complex sclerosing and papillary lesion

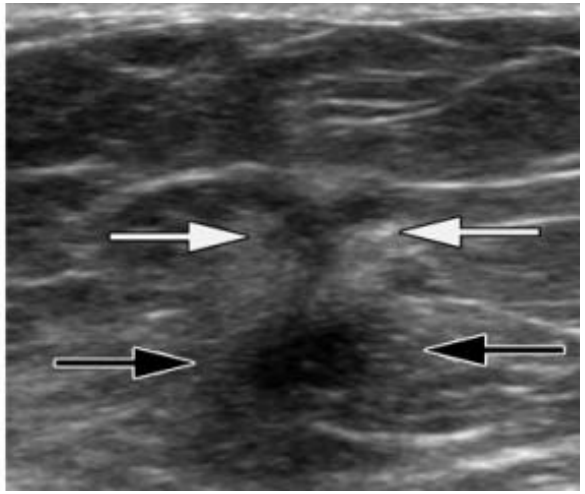
Tubular or ductal architecture



DCIS

Associated findings

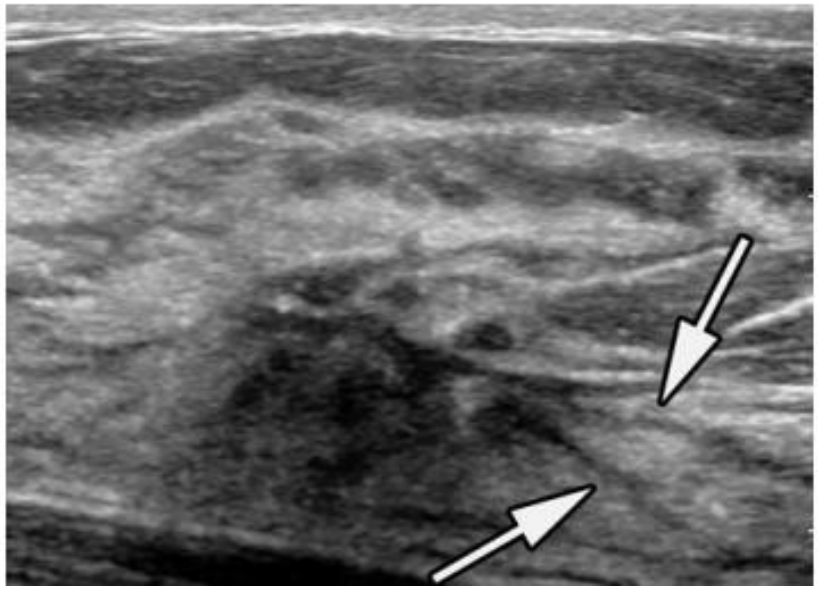




Posterior acoustic shadowing

corresponding to mammographic architectural distortion
CNB & surgical excisional : biopsy confirmed dense fibrous tissue

corresponding to a palpable concern and mammographic focal asymmetry
invasive lobular carcinoma



Architectural distortion

at the site of mammographic architectural distortion
dense fibrous stroma, focal lymphocytic mastitis, and histiocytic reaction.

The most common benign histopathologic finding (75%) in a nonmass finding was *fibrocystic change*.

The most common breast cancers identified as

nonmass findings on US images were *DCIS or ILC*

CORRELATION BETWEEN BREAST US AND MAMMOGRAPHIC FINDINGS

malignant nonmass findings at US are more often associated wit mammographic abnormalities than are benign nonmass findings (84% vs 40%)

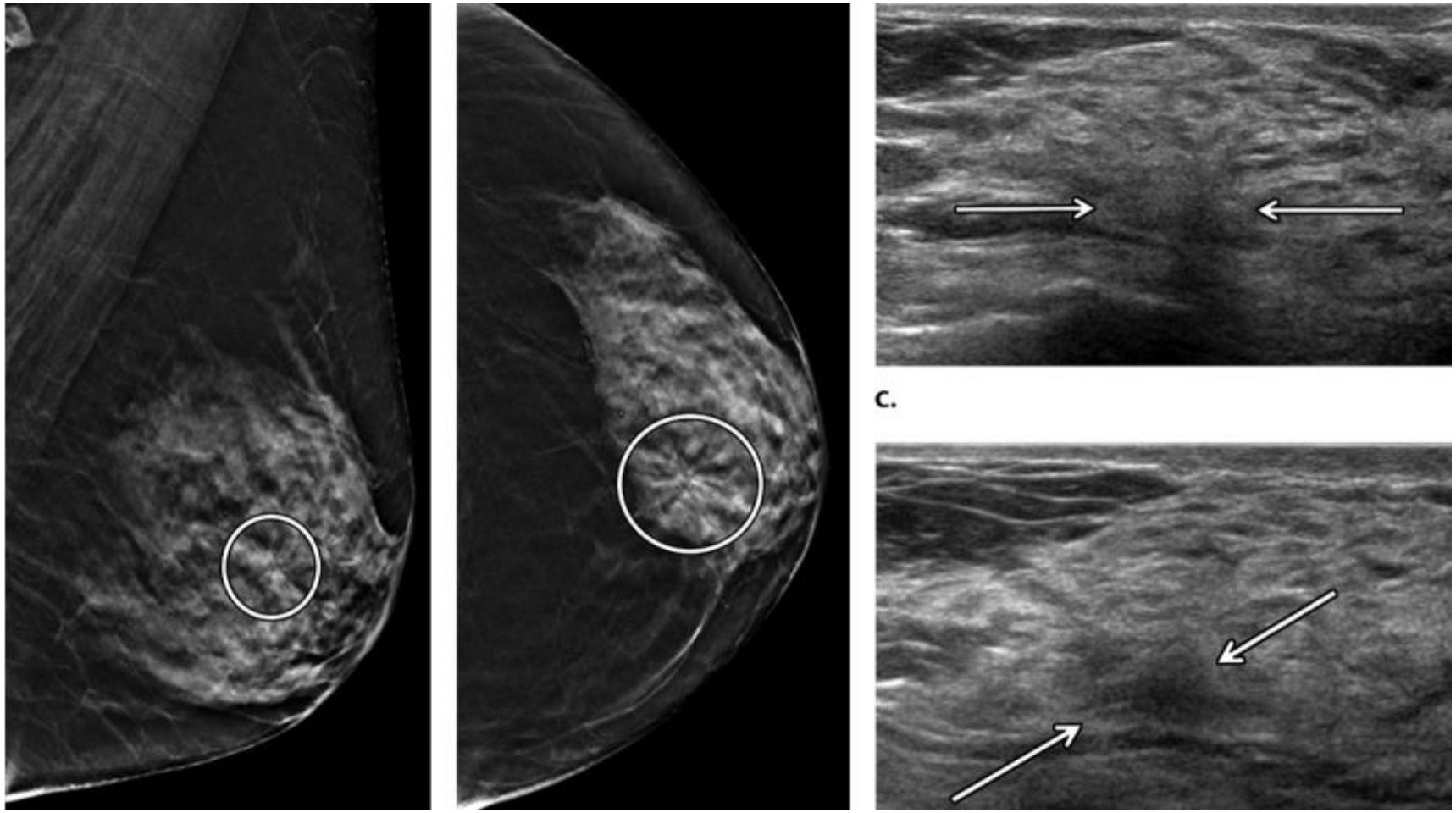
Mammographic lesions that most often appear as nonmass findings on US images include

- ***Calcifications***
- ***a focal or developing asymmetry***
- ***architectural distortion***

US correlate of mammographic architectural distortion

US: focal hypoechoic nonmass finding

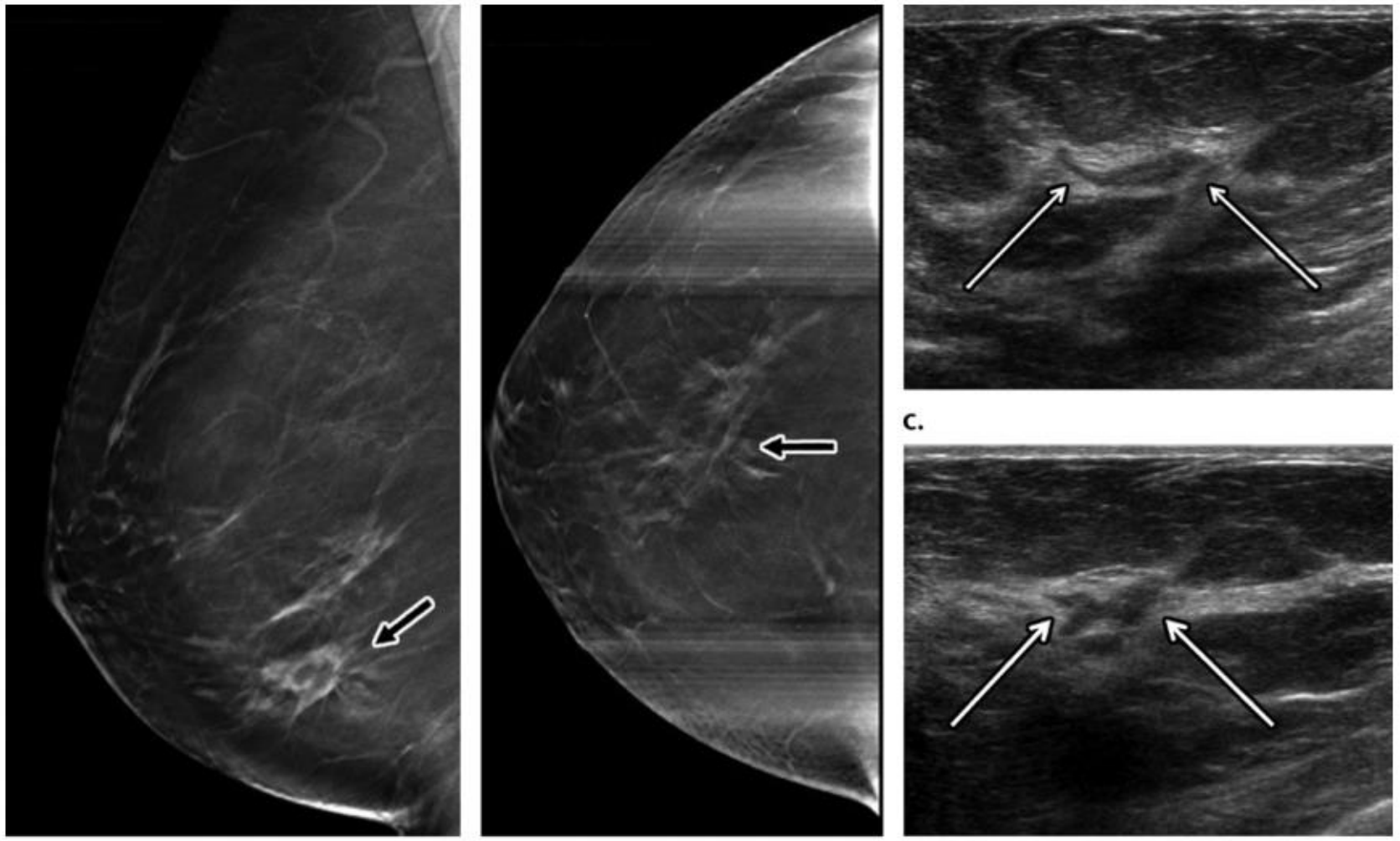
invasive carcinoma with ductal and lobular features and DCIS



US correlate of mammographic architectural distortion

hypoechoic linear nonmass

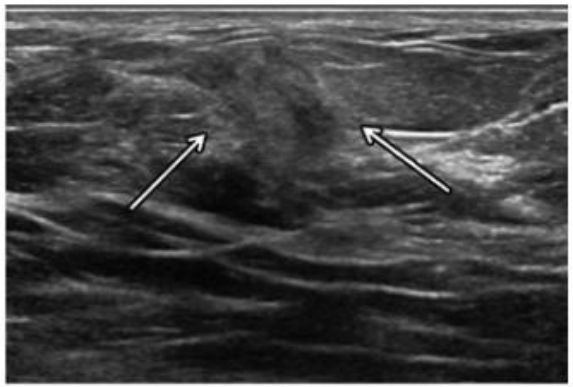
Bx: ADH



US correlate of mammographic focal asymmetry , history of lupus

focal predominantly hyperechoic nonmass

atypical lymphoid infiltrate, compatible with lupus mastitis



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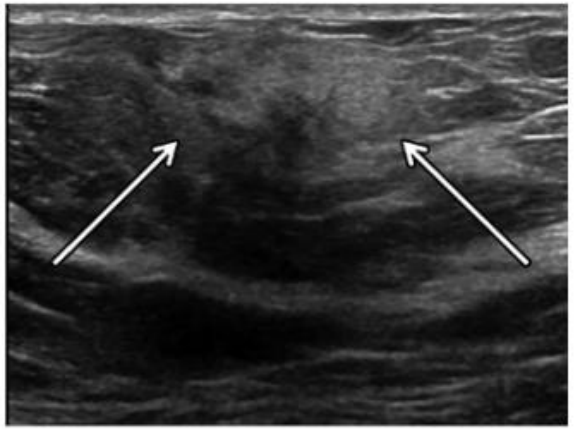

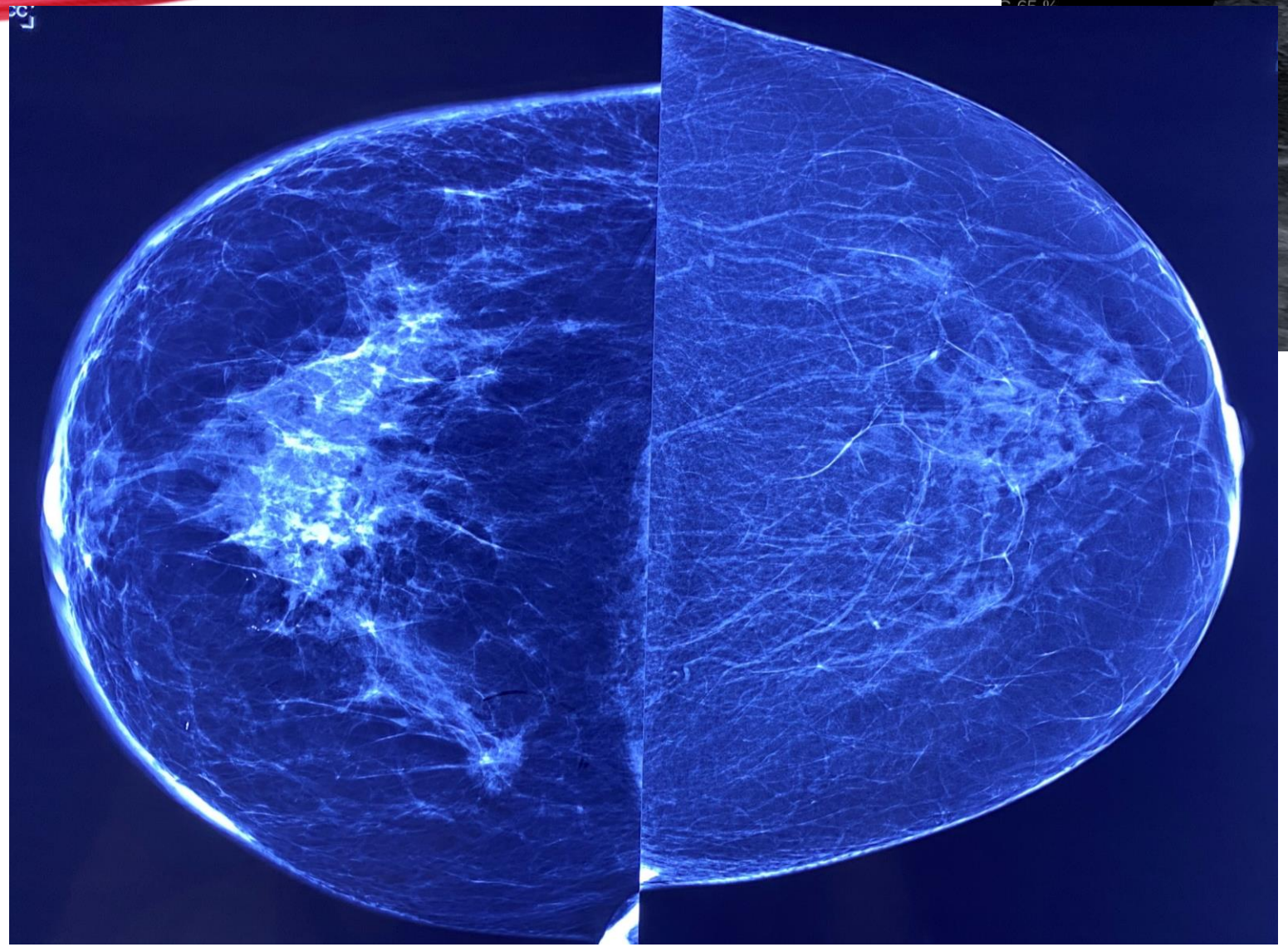

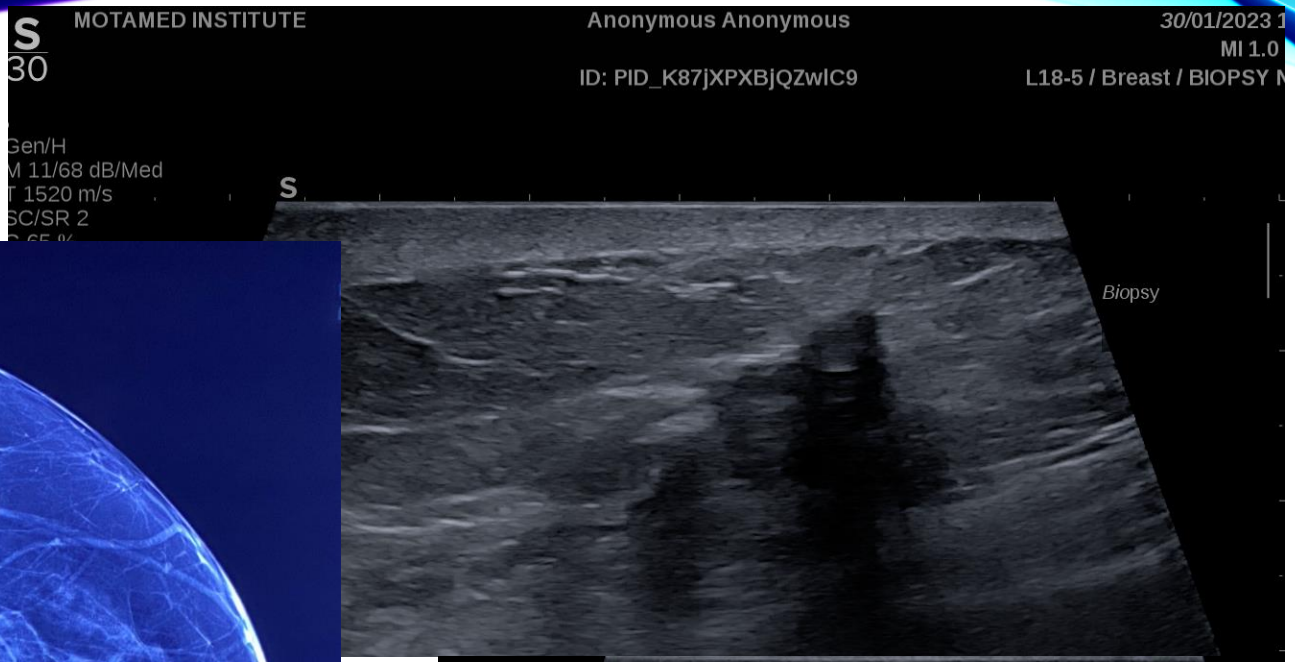
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ID: PID_K87jXPXBjQZwlC9
L18-5 / Breast / BIOPSY N
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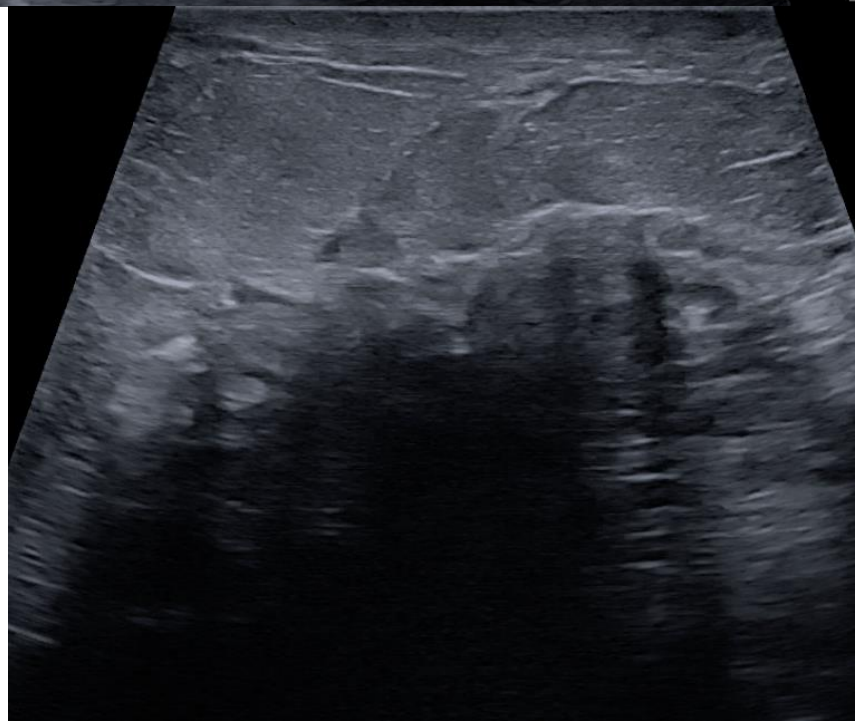
SC/SR 2
Biopsy



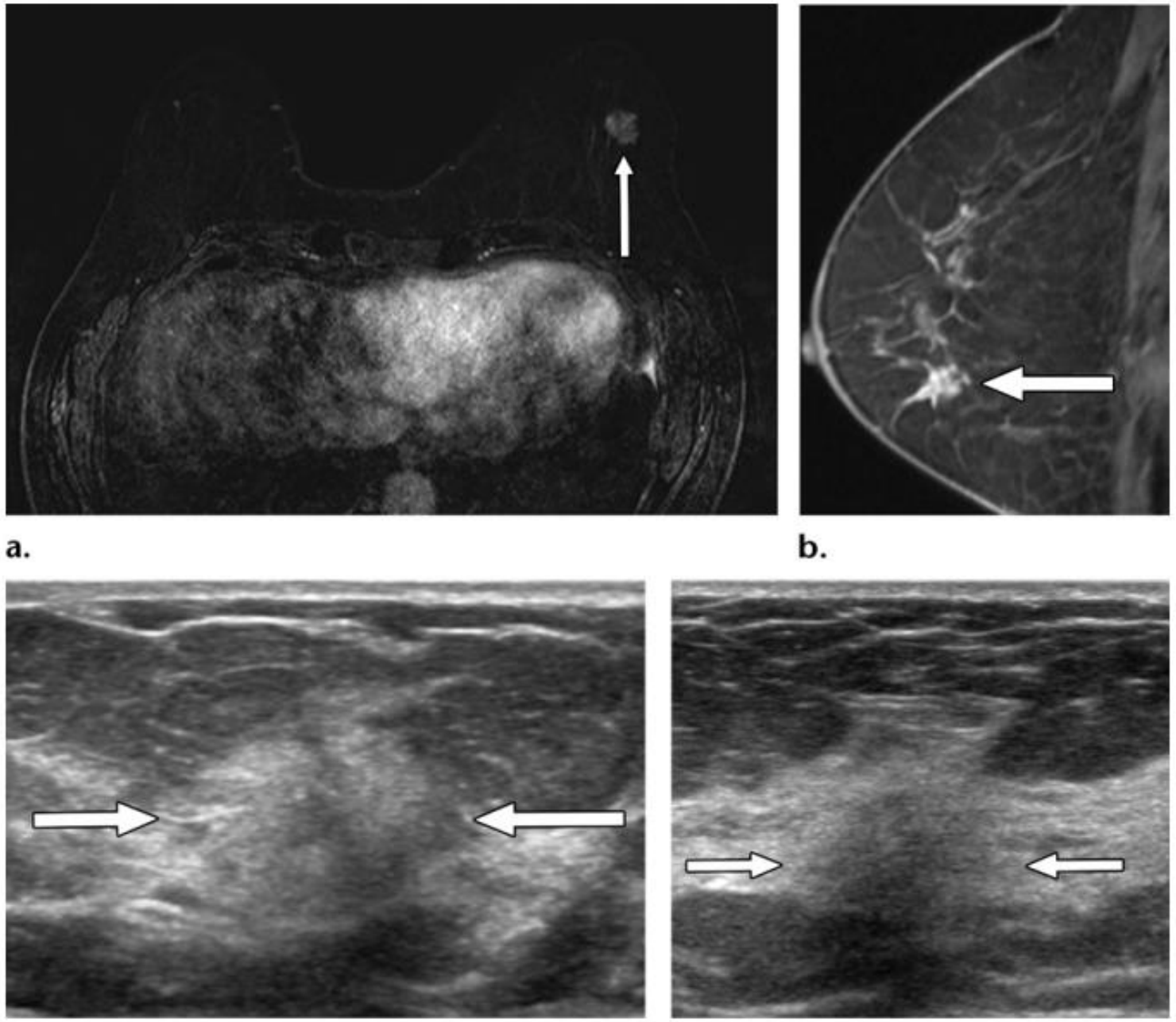
CORRELATION BETWEEN BREAST US AND MRI FINDINGS

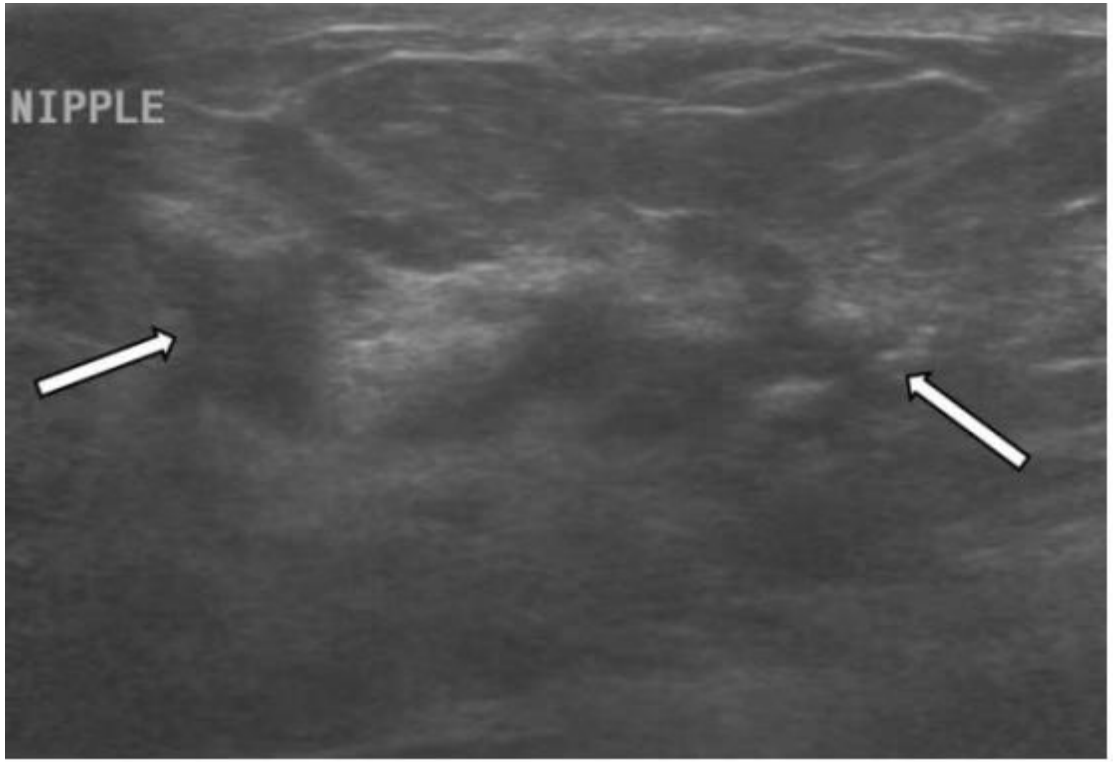
- US correlates for DCIS, which appear as nonmass enhancement at MRIvague areas of decreased echogenicity or altered echotexture," or nonmass findings
- nonmass findings at US tend to appear as nonmass enhancement at MRI as well.
- 40% of nonmass findings at US have corresponding enhancing lesions at MRI, and of these findings, 97% were nonmass enhancement at MRI.

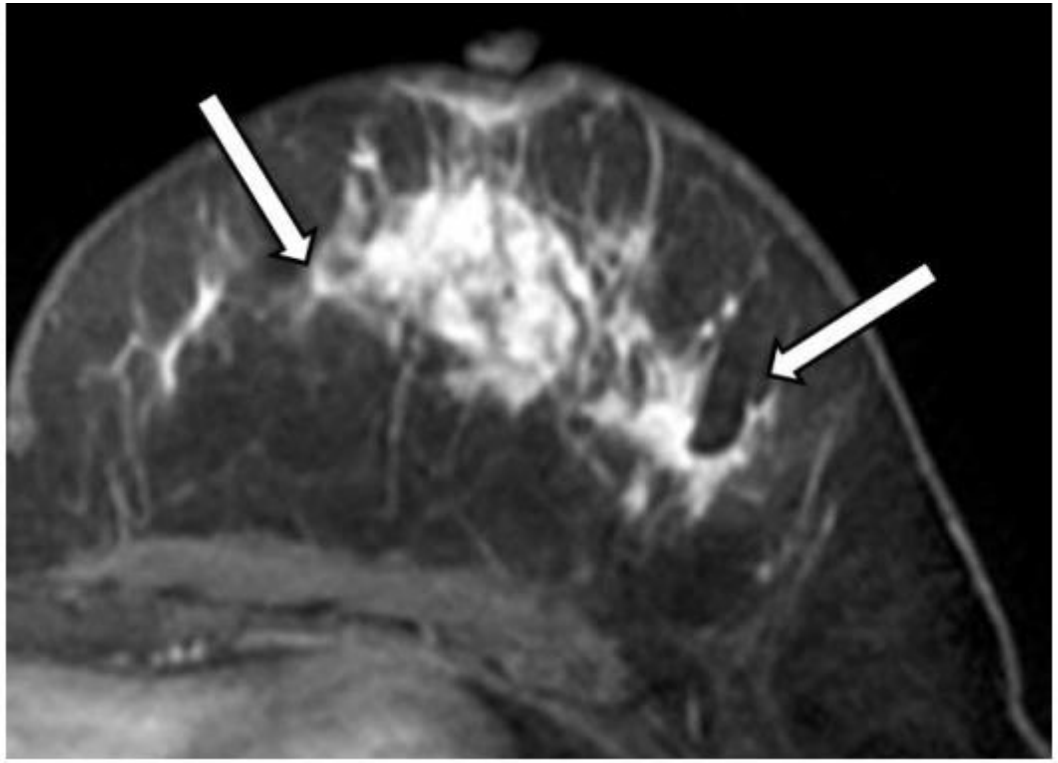
Nonmass finding as a US correlate of MRI nonmass

history of BRCA2 mutation,
focal nonmass enhancement in MRI
nonmass finding with
mixed echogenicity in US

ILC





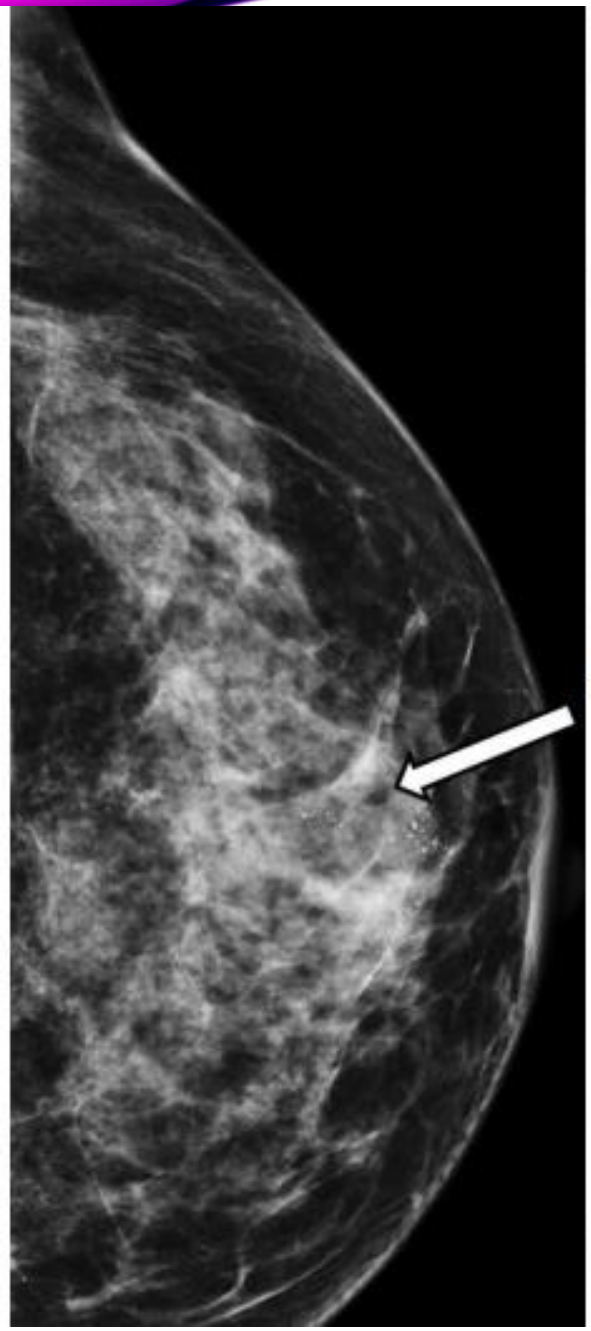


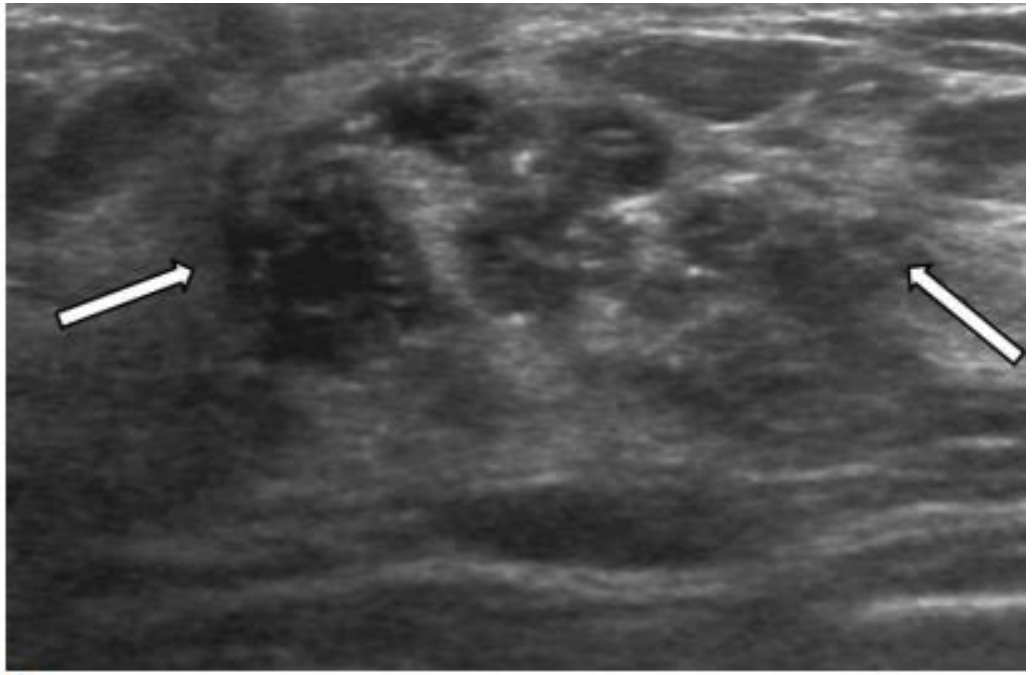
IDC+DCIS

Mammo: Indistinct and round microcalcifications are regionally distributed in subareolar area

US: nonmass with internal microcalcifications

MRI: non-mass-like enhancement with segmental distribution and internal heterogeneous enhancement





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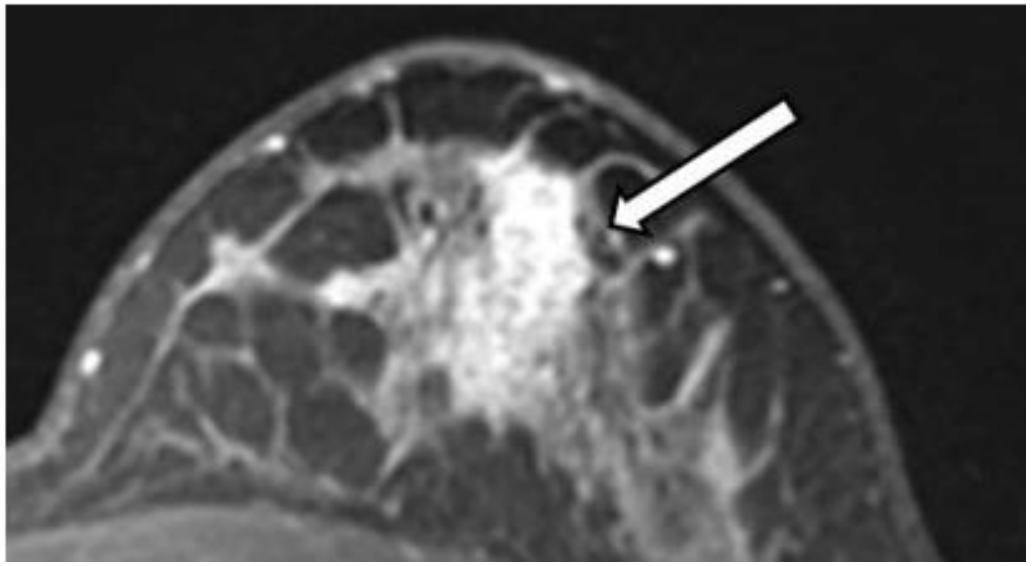


ELASTOGRAPHY FOR BREAST NON-MASS LESIONS

- As a new and non-invasive detection technique, ultrasonic elastography (UE) can qualitatively and quantitatively measure tissue stiffness
- Malignant tissue is usually harder than surrounding normal tissue
- UE can facilitate characterization of breast NMLs and thereby avoid 46–87.5% of benign biopsies
- The pooled sensitivity, specificity, positive likelihood ratio, and negative likelihood of elastography for the differentiation of benign and malignant breast NMLs were 79% ,86%, , 5.67 and 0.24, respectively.

ELASTOGRAPHY FOR BREAST NON-MASS LESIONS

- The qualitative measurement index is simpler, with relatively unified standards based on strain and colour pattern **(elasticity score of 3)**
- various quantitative indexes were used in seven included studies; these included the mean elasticity (Emean), maximum elasticity (Emax), minimum elasticity (Emin), and strain ratio (SR). The cut-off value of these parameters in each study also differed, potentially resulting in heterogeneity
- Qualitative measurement indexes involve naked-eye evaluation of the hard area ratio, and thus are operator-dependent.
- In contrast, quantitative measurement indexes assess tissue stiffness with specific numerical data, providing objective assessment for clinical practice. Therefore, further studies comparing these two types of measurement indexes are required

Table 2. Elastography Score for Breast Cancer Classification [1]

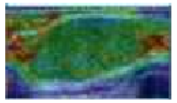
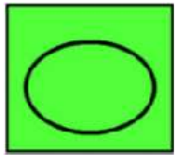
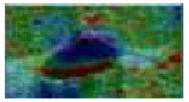
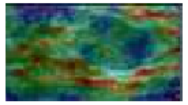
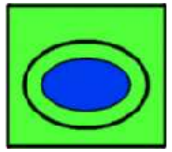
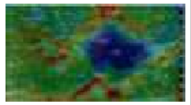
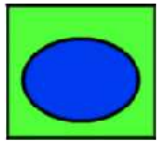
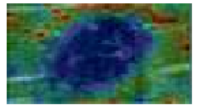
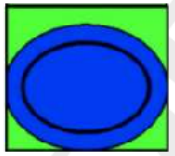
Score	Image	Color	Description	Class
1			Entire area is evenly shaded green, as is surrounding tissue	**Benign**
2			Lesion area shows a mosaic pattern of green and blue.	
3			Central part of the area is blue (stiff), and peripheral part is green (soft).	**Intermediate** (Probably Benign)
4			Entire area is blue (stiff).	**Malignant**
5			Entire area and its surrounding area are blue (stiff).	

Table 3. Comparative analysis of artifacts present in the sonographic breast elastography images for both strain based and shear wave based elasticity

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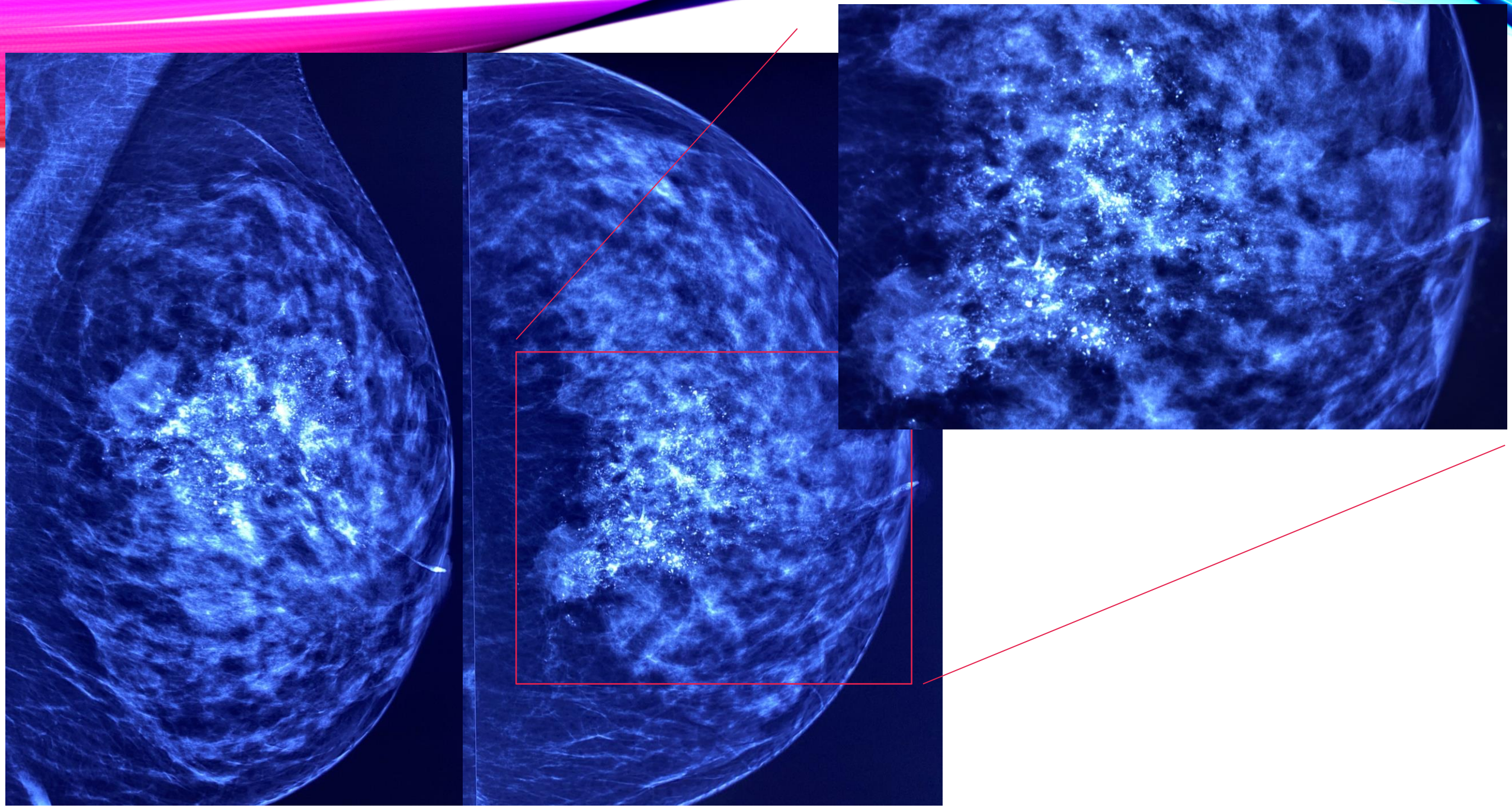
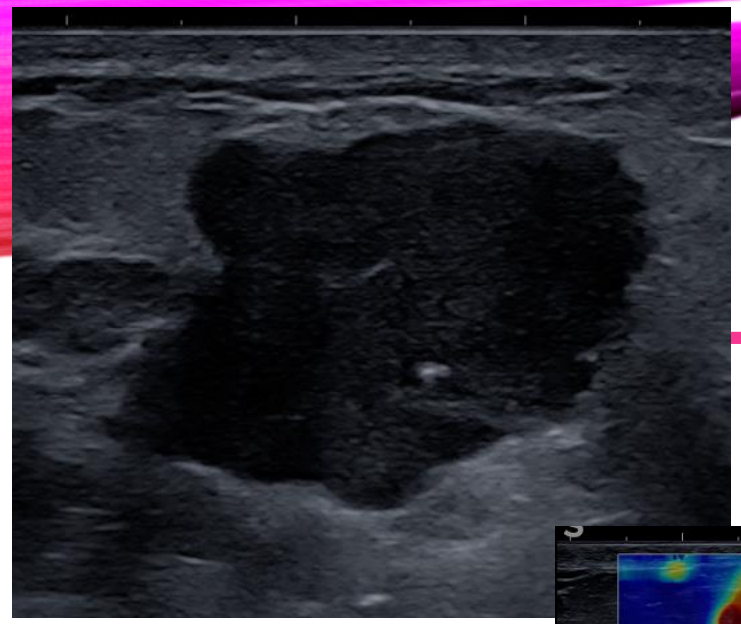
Diagnostic performance of elastography for breast non-mass lesions: A systematic review and meta-analysis

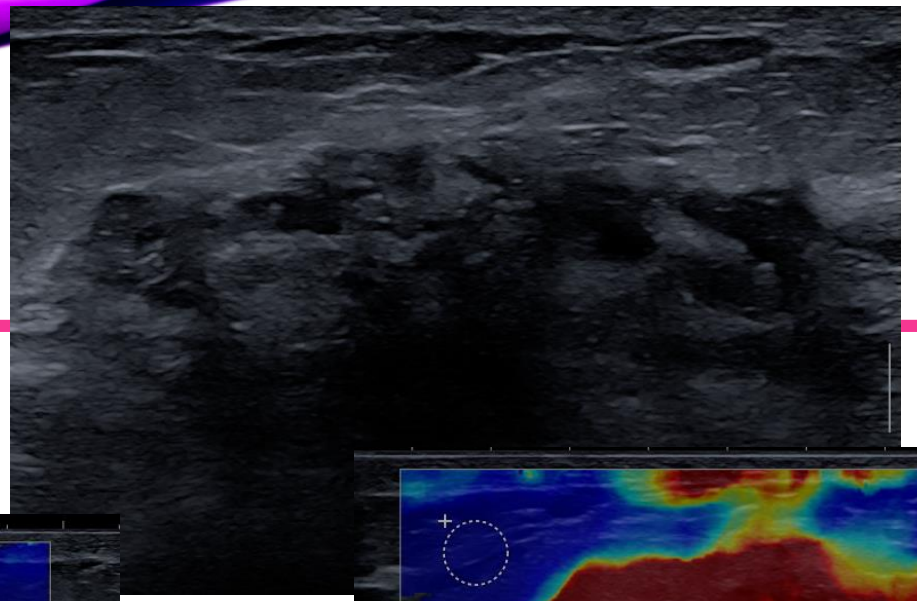
Shaofu Hong [a,1], Weiyue Li [b,1], Wenjing Gao [a], Mengmeng Liu [a], Di Song [a], Yinghui Dong [a], Jinfeng Xu [a,*], Fajin Dong [a,*]

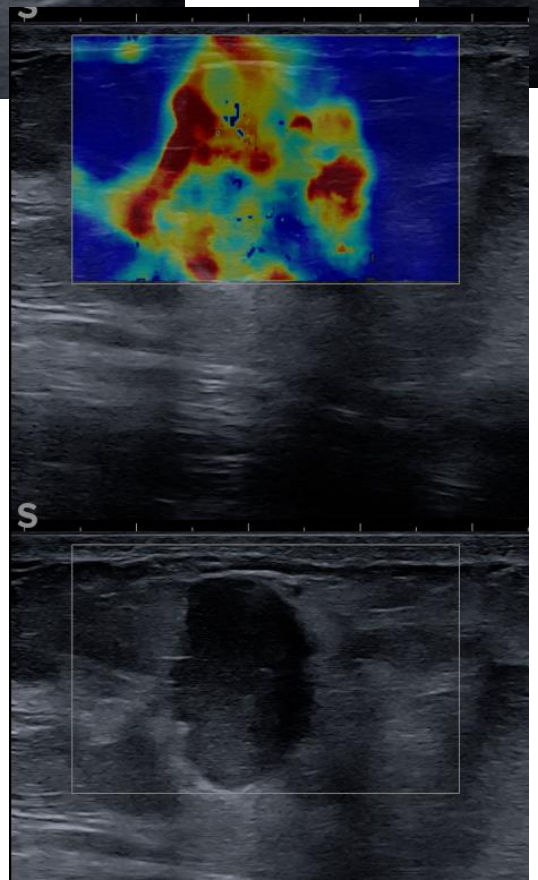
Table 1
Characteristics of the included studies.

Author/ Year	County	Design	Type of elastography	Measurementindex	Cutoff value	No. of Lesions (No. of malignant lesions)	TP	FP	FN	TN	Se (%)	Sp (%)
Ko 2012	Korea	Retrospective	SE	Elasticity score	>Score 3	36(21)	12	0	9	15	57.1	100
Ko 2013	Korea	Retrospective	SWE	Emean	41.6 kPa	34(12)	10	7	2	15	83.3	68.2
Choi 2016	Korea	Retrospective	SWE	Emean	85.1 kPa	116(74)	58	2	16	40	78.4	95.2
Wang 2016	China	Retrospective	SWE	Emax	81.07	67(33)	21	7	12	27	63.3	79.4
Li 2017	China	Prospective	SE	Elasticity score	>Score 3	77(46)	39	7	7	24	84.8	77.4
Park 2017	Korea	Retrospective	SWE	Emean	85.1 kPa	152(79)	54	5	25	68	68.4	93.2
Aslan 2018	Turkey	Retrospective	SWE	NA	NA	53(22)	18	8	4	23	81.8	74.2
Zhang 2018	China	Retrospective	SE	Elasticity score	>Score 3	71(40)	33	9	7	22	82.5	71.0
Qu 2019	China	Retrospective	SE	Strain ratio	4.07	39(23)	21	1	2	15	91.3	93.8
Xu 2020	China	Retrospective	SWE	E2.5max	94.62 kPa	118(52)	49	8	3	57	94.6	85.9
Sepideh 2021	Iran	Retrospective	SWE	Emean	72 kPa	49(12)	7	4	5	33	58.3	89.2





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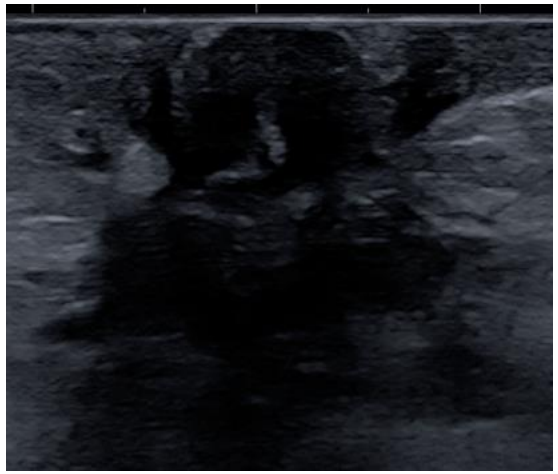

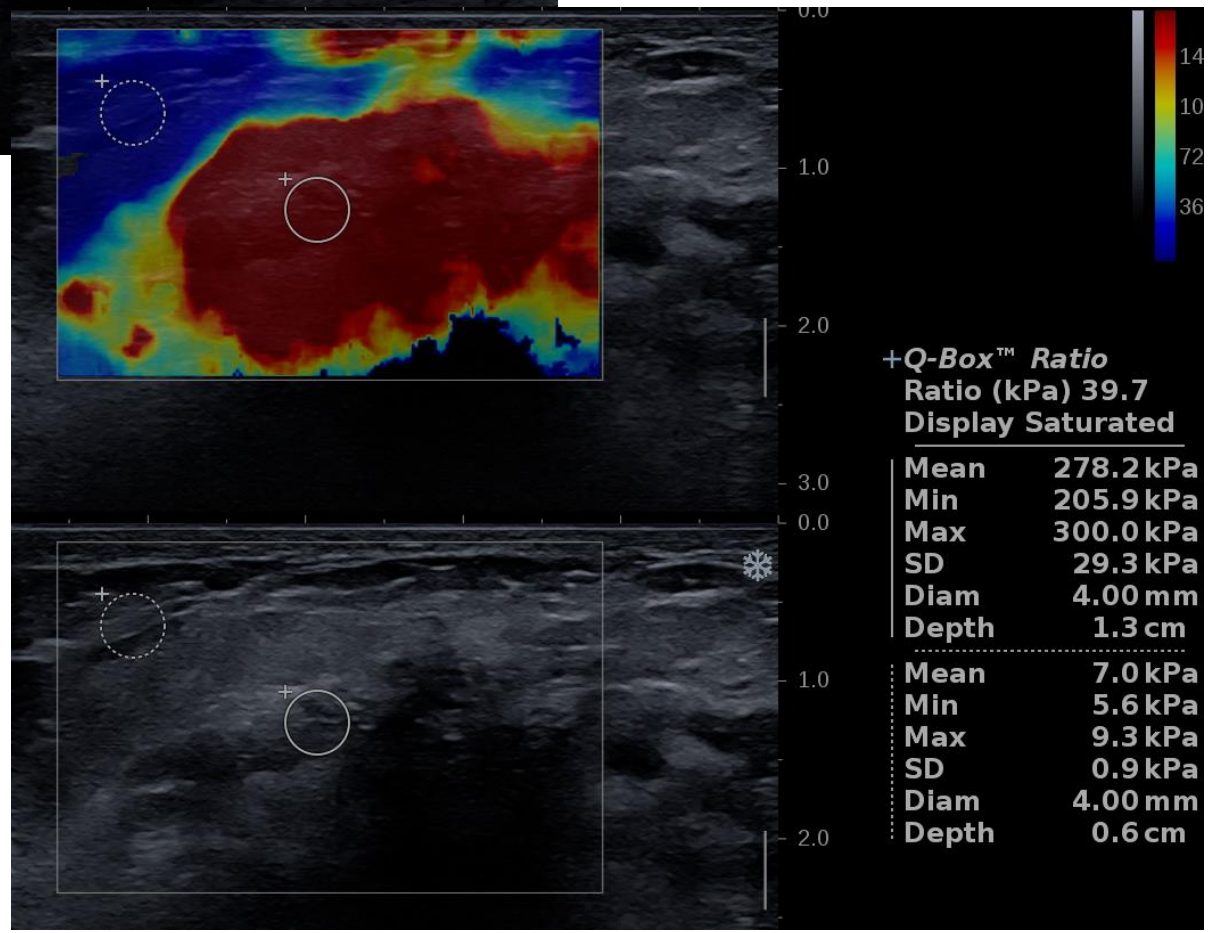
0.0
1.0
2.0
3.0
0.0
1.0
2.0
14
10
72
36
+Q-Box™ Ratio
Ratio (kPa) 39.7
Display Saturated
Mean 278.2 kPa
Min 205.9 kPa
Max 300.0 kPa
SD 29.3 kPa
Diam 4.00 mm
Depth 1.3 cm
Mean 7.0 kPa
Min 5.6 kPa
Max 9.3 kPa
SD 0.9 kPa
Diam 4.00 mm
Depth 0.6 cm

BIOPSY

US-guided biopsy is generally preferred because it is less expensive and better tolerated by patients.

Given the subtle nature of nonmass findings, performing stereotactic core biopsy may be preferable when there is sonographic uncertainty


THANK YOU
FOR YOUR
ATTENTION