

In the name of GOD

Non-Mass Enhancement
at breast MRI


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TEHRAN UNIVERSITY
OF
MEDICAL SCIENCES

Management of Non-Mass Enhancement at Breast Magnetic Resonance in Screening Settings Referred for Magnetic Resonance-Guided Biopsy

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ORIGINAL ARTICLE



Grading system to categorize breast MRI using BI-RADS 5th edition: a statistical study of non-mass enhancement descriptors in terms of probability of malignancy

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BREAST IMAGING 1343

Patterns of Nonmasslike Enhancement at Screening Breast MRI: Imaging of

BREAST

Interobserver variability and likelihood of malignancy for fifth edition BI-RADS MRI descriptors in non-mass breast lesions

Nonmass Enhancement on Breast MRI: Review of Patterns With Radiologic-Pathologic Correlation and Discussion of Management

RadioGraphics

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AJR:204, January 2015



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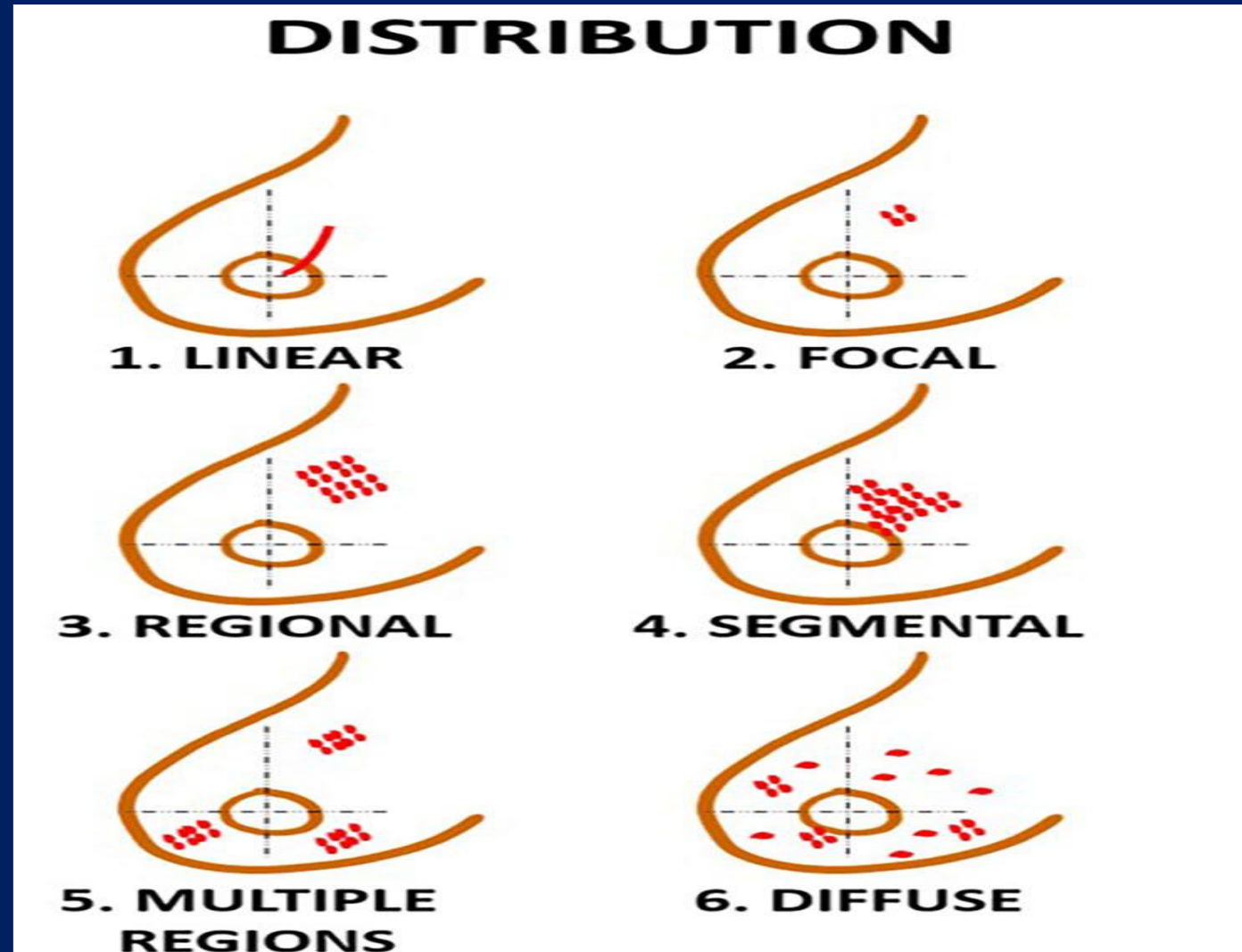
Titles:

- NME definition
- NME characteristics in breast MRI
- NME and asymmetric BPE
- Differentiation between benign NME and malignant NME
- Management of NMEs at breast MRI

NME definition

- an area that is **neither a mass nor a focus** (<5-mm area of enhancement)
- **small or large regions** and in which **internal enhancing characteristics are discrete** from normal surrounding background parenchymal enhancement
- NME may have **areas or spots of normal fibroglandular tissue or fat** between abnormally enhancing components

NME Distribution in breast MRI

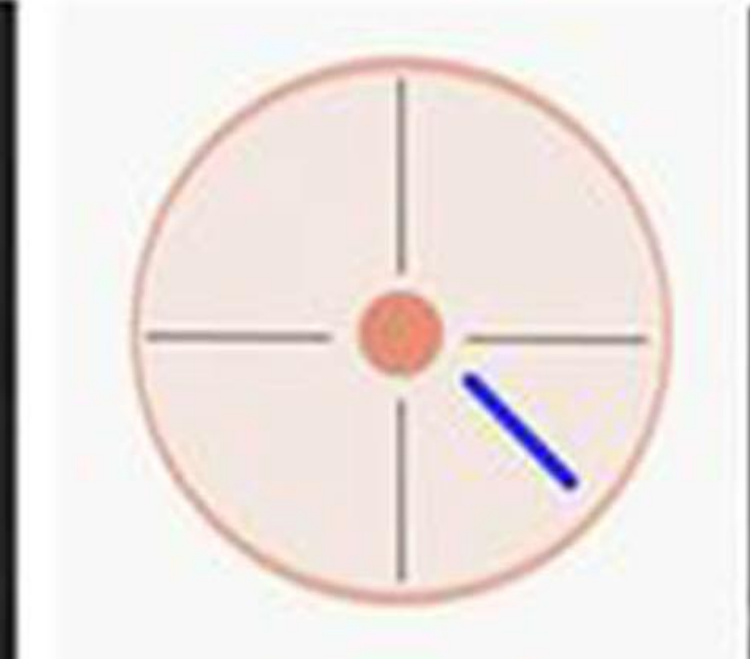
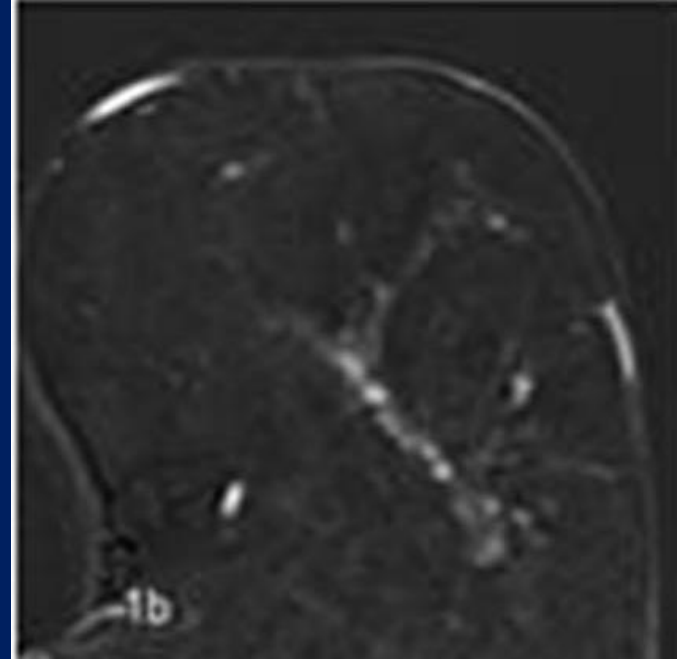
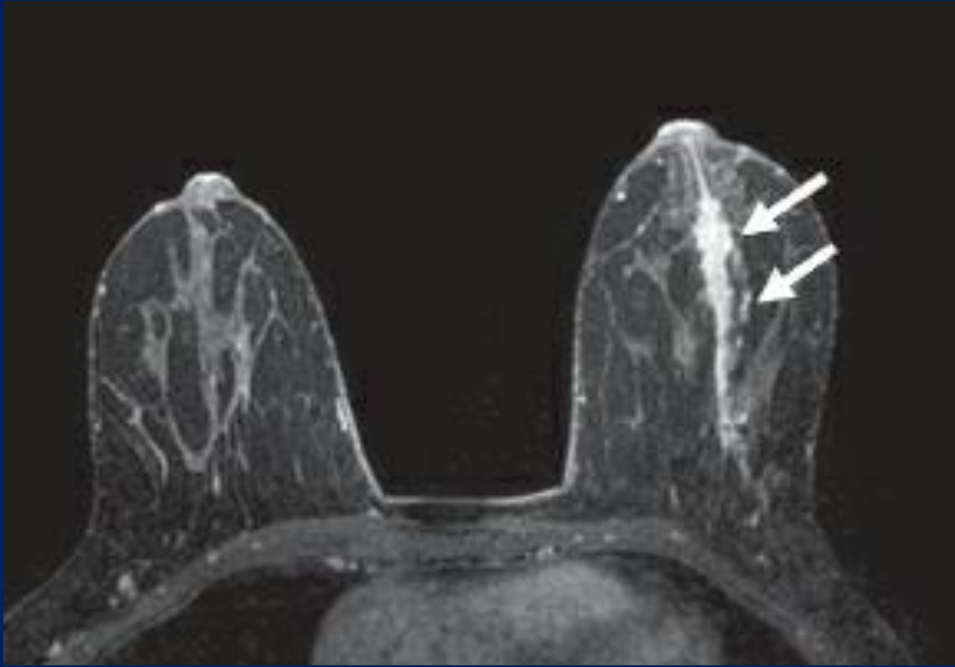


Focal NME: less than 25% of quadrant



A 49-year-old woman with usual ductal hyperplasia and fibrosis.

Linear NME:

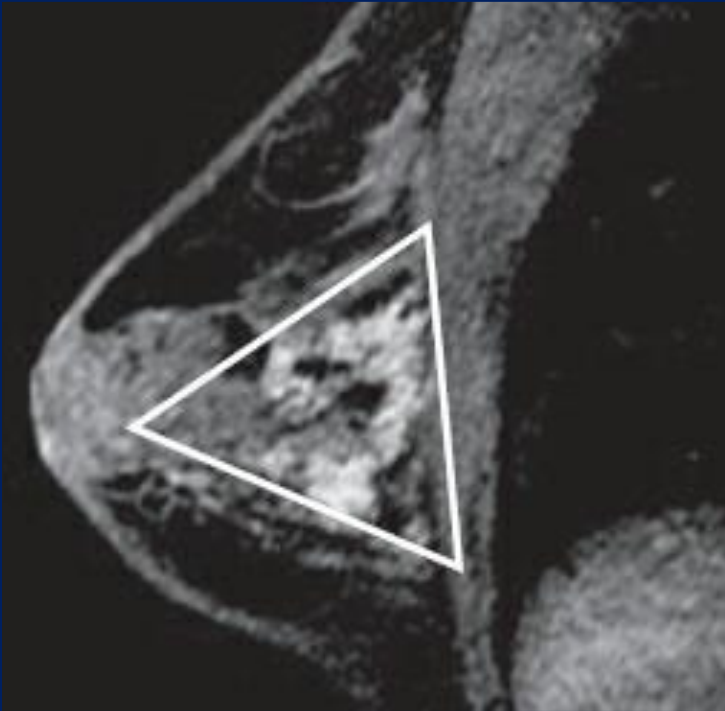


Enhancement in a line: straight, curved, or branching arrangement of enhancement, suggestive of ductal or periductal involvement

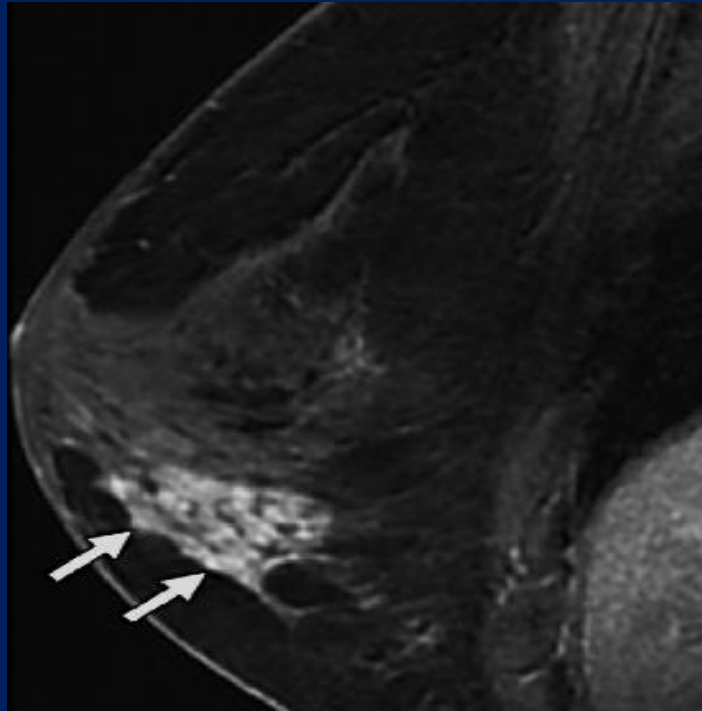
DCIS

Segmental NME:

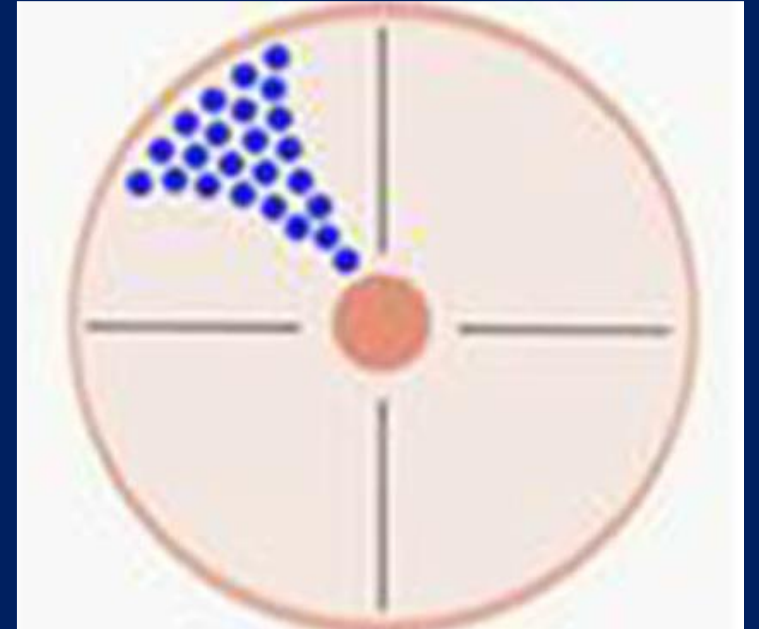
Triangular or conical, apex pointing to nipple,



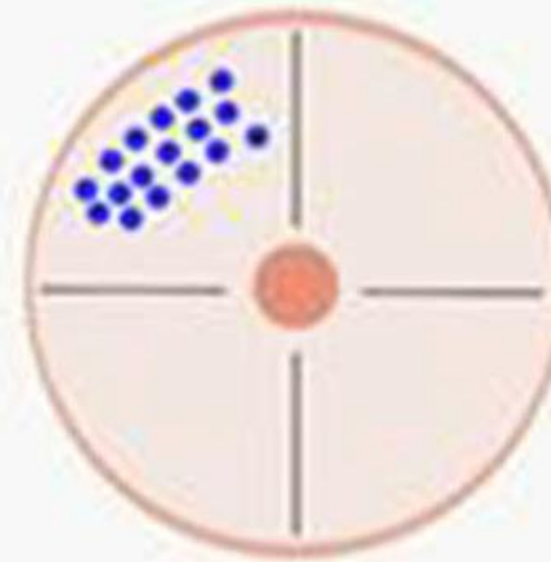
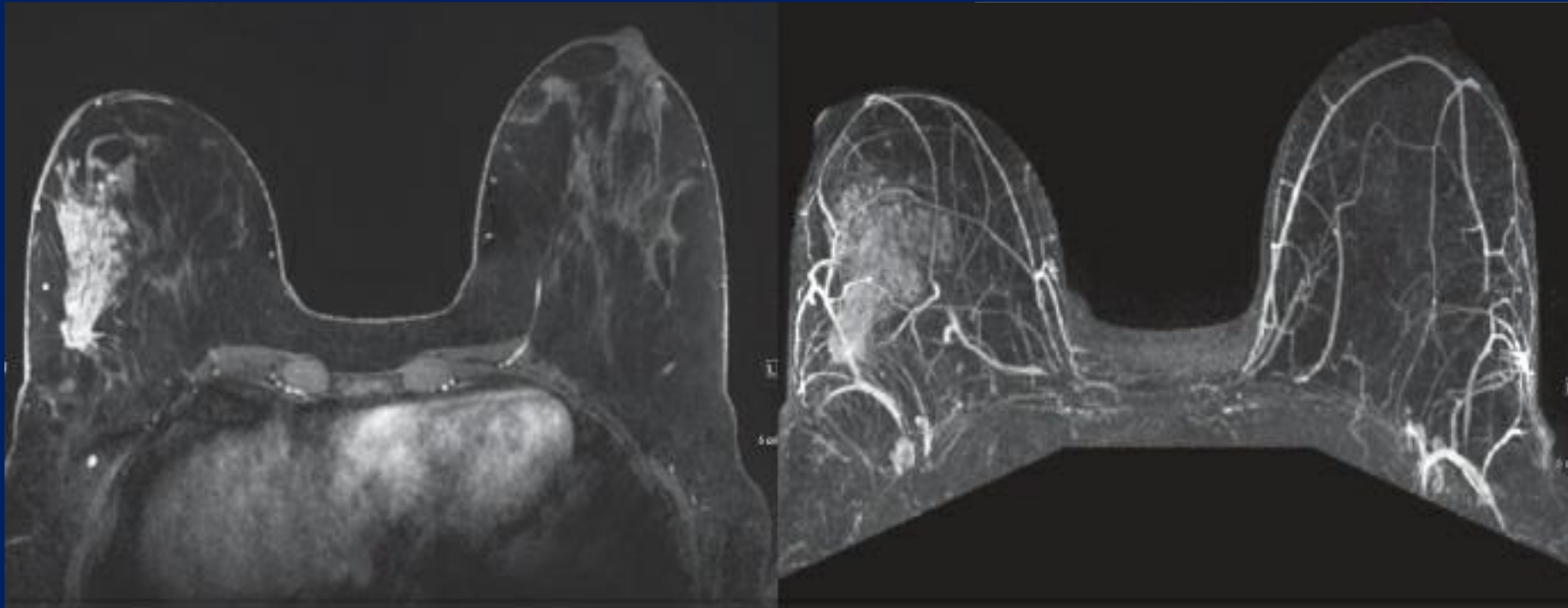
invasive lobular carcinoma.



DCIS

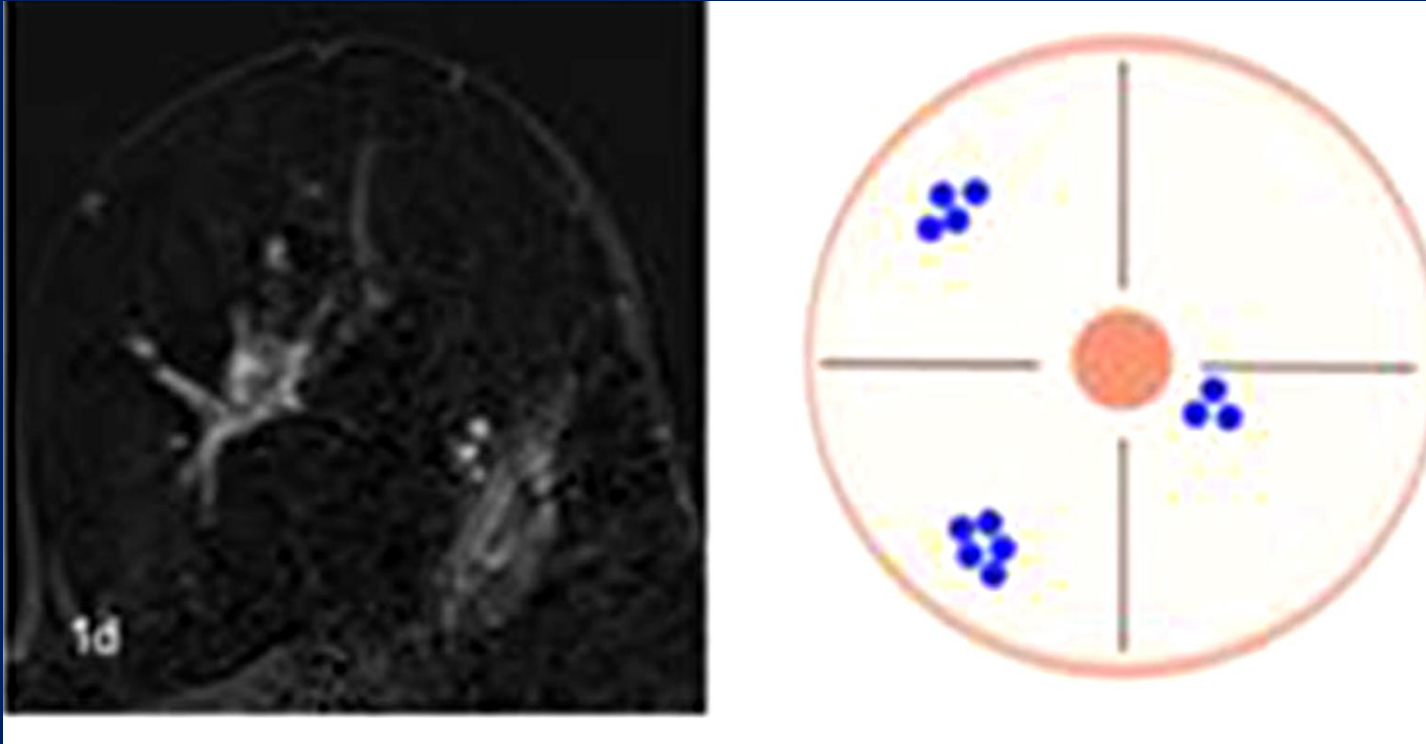


Regional NME:

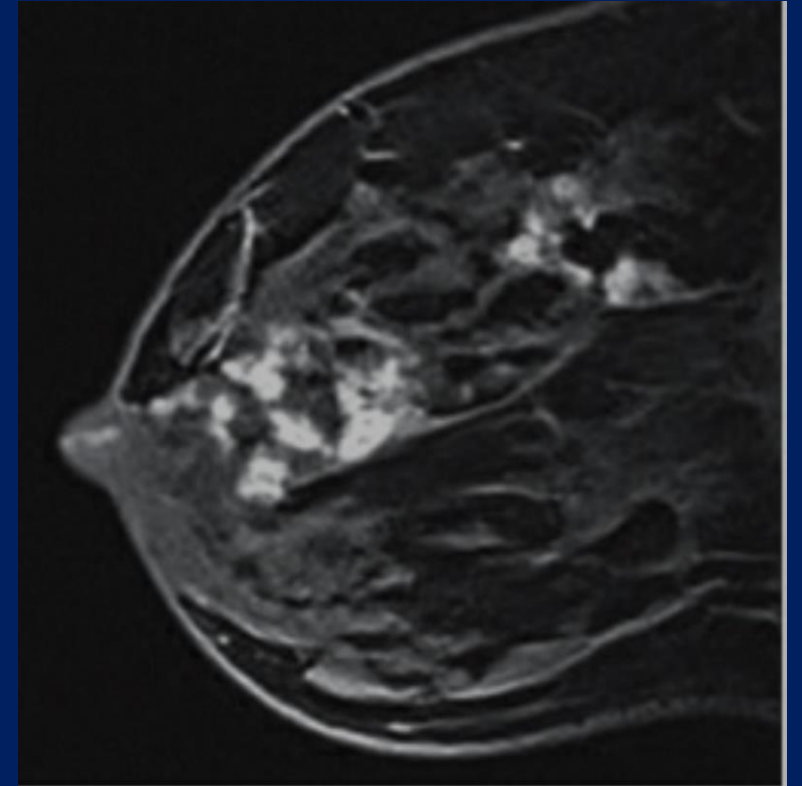


area larger than a breast quadrant
geographic
not conforming to duct distribution

Multiple regions NME:

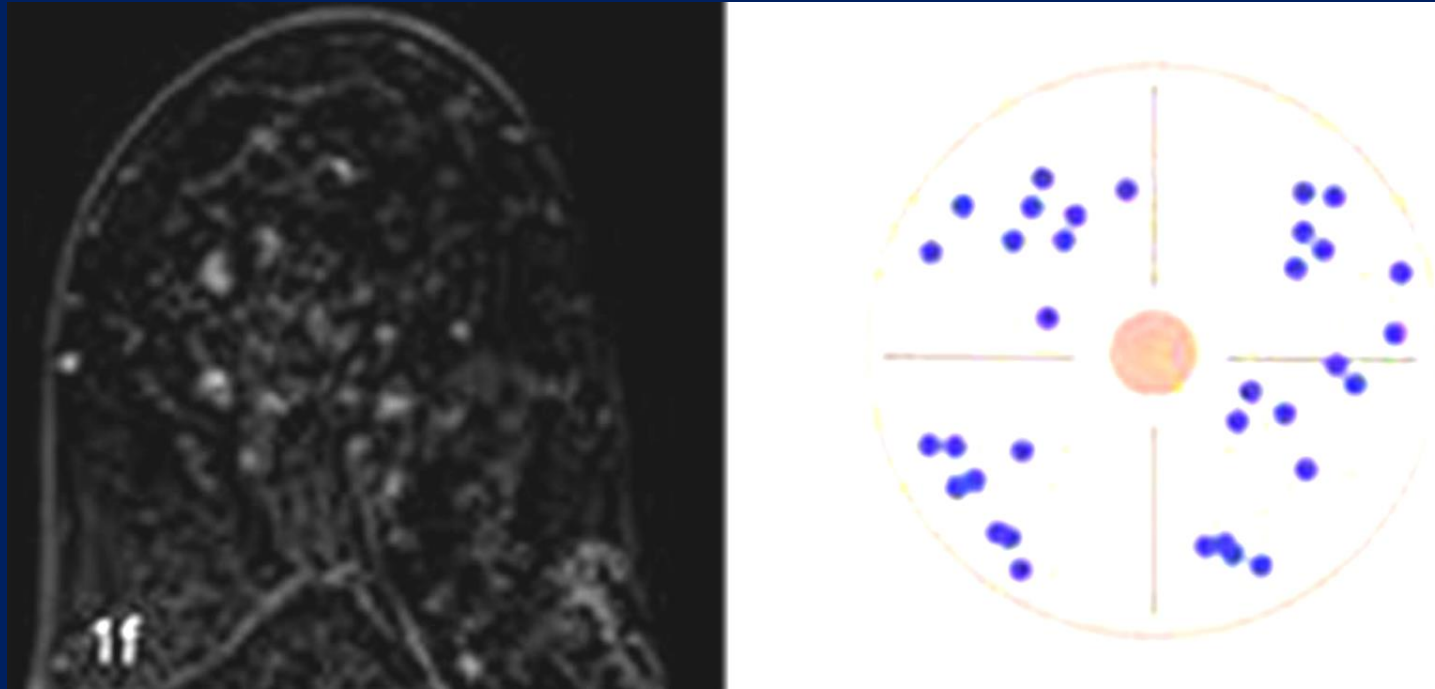


enhancement over at least two large volumes of tissue
separated by normal tissue
not conforming to a ductal distribution (patchy)

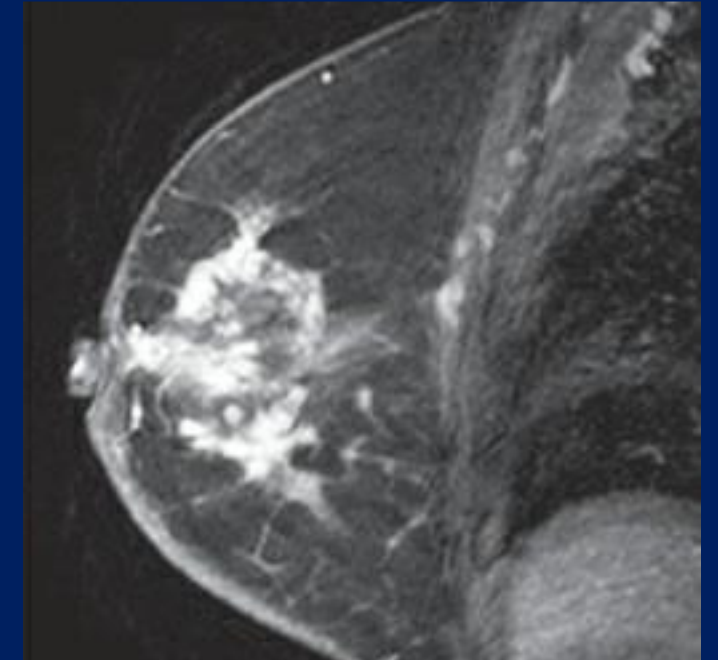


A 74-year-old woman
invasive lobular carcinoma.

Diffuse NME:



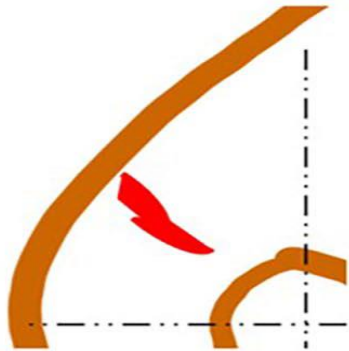
distributed randomly throughout the breast
A 47-year-old woman with fibrocystic changes



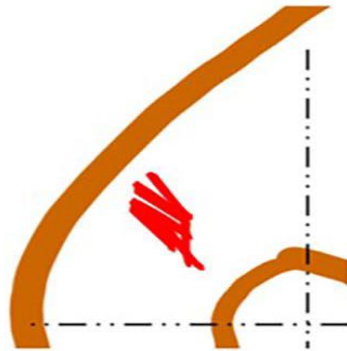
49y/o
IDC

NME Internal enhancement patterns

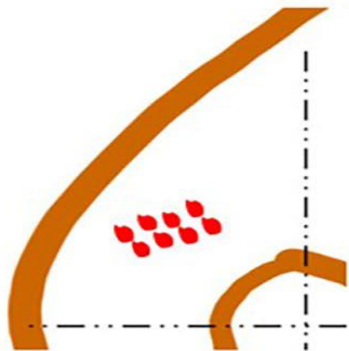
INTERNAL ENHANCEMENT PATTERN



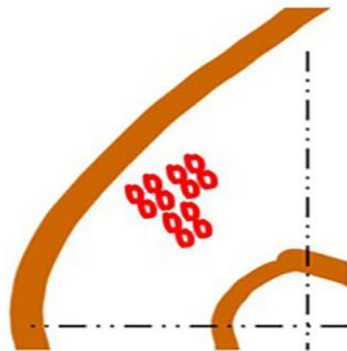
1. HOMOGENEOUS



2. HETEROGENEOUS



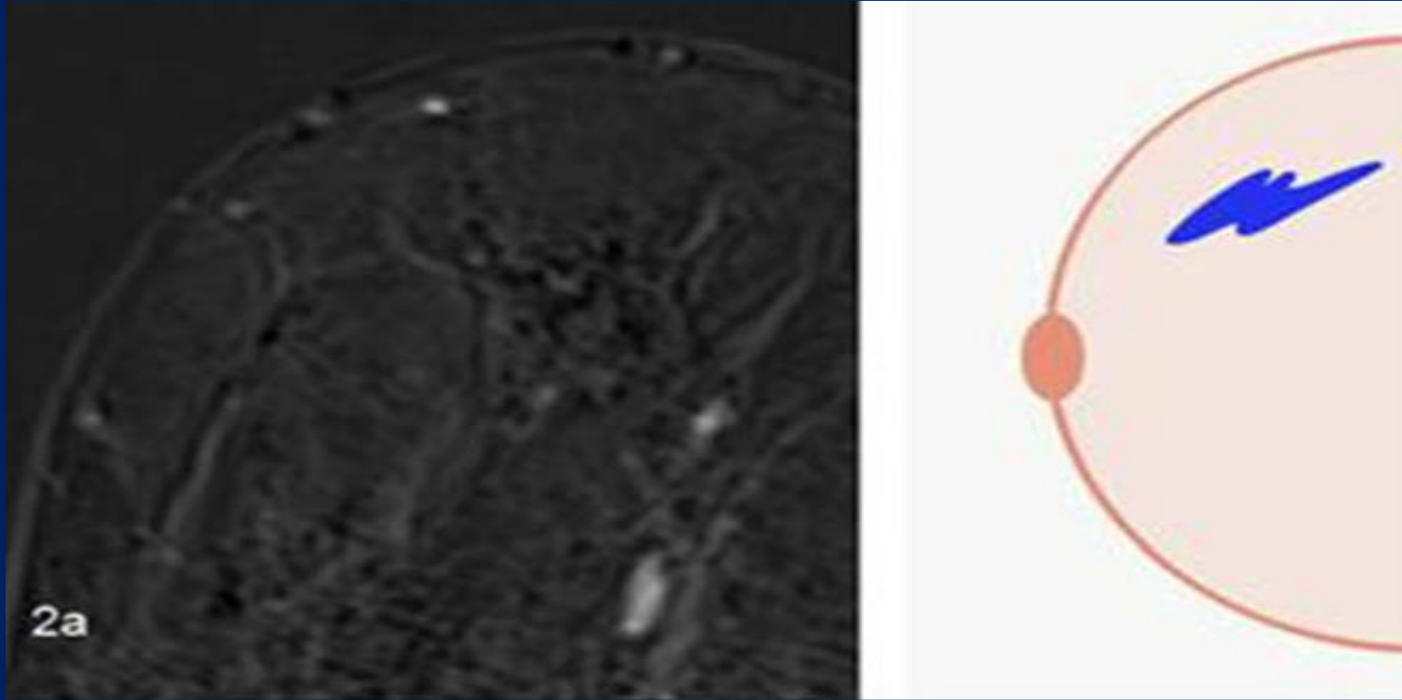
3. CLUMPED



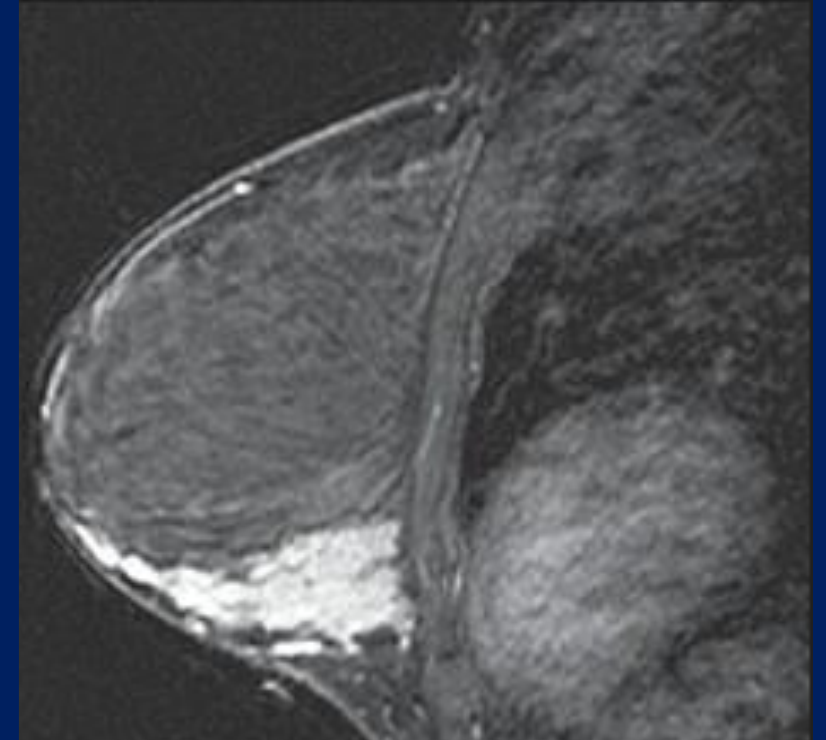
4. CLUSTER RING

~~Stippled, punctate ,
"sand-like" or dot-like
Reticular, dendritic –
finger-like projections~~

Homogenous enhancement NME: confluent and uniform

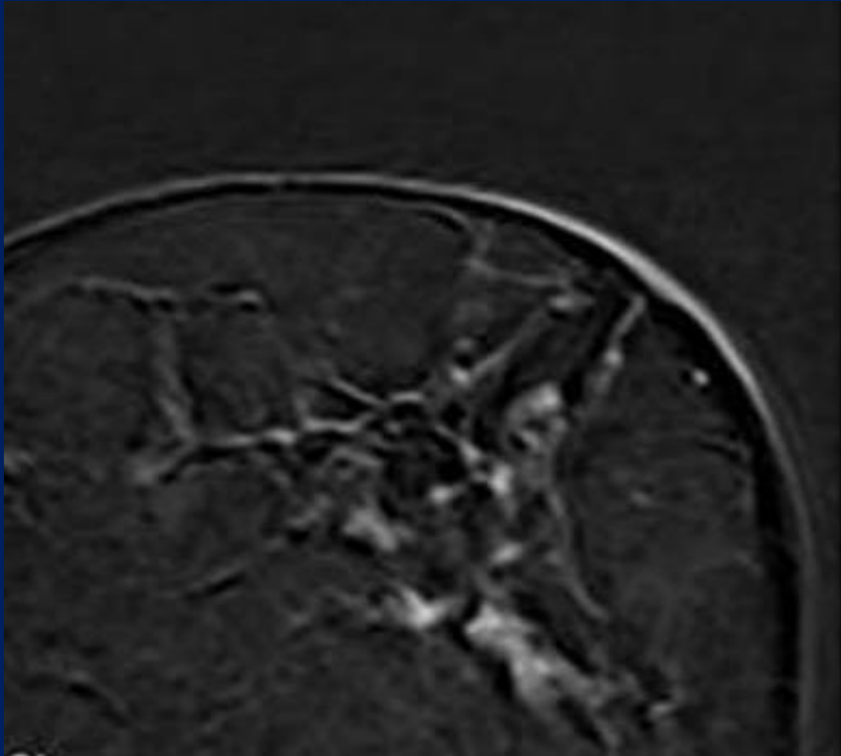


usual ductal hyperplasia.

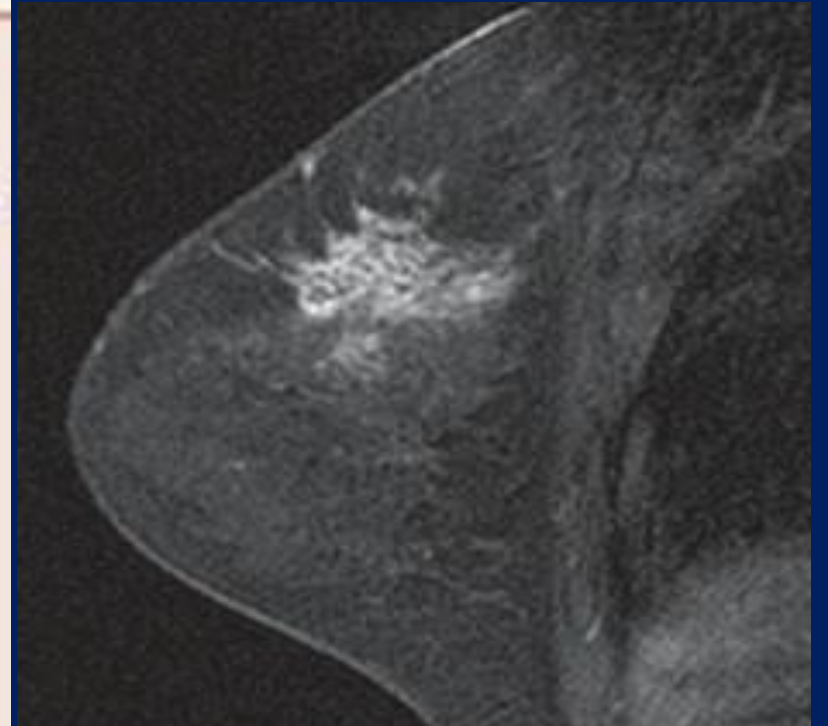


Sclerosing Adenosis

Heterogeneous enhancement NME:
non-uniform pattern
randomly separated by normal tissue



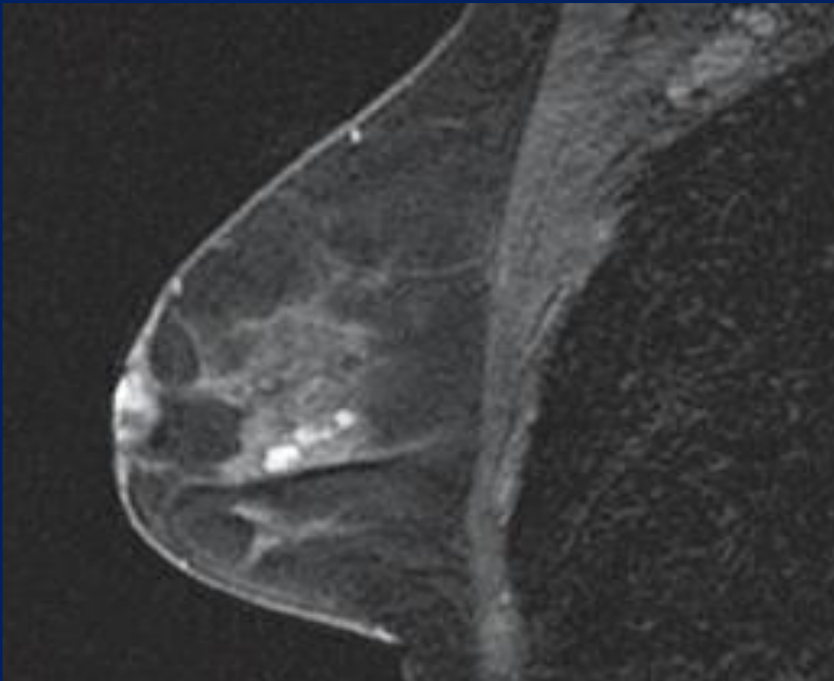
apocrine focal metaplasia



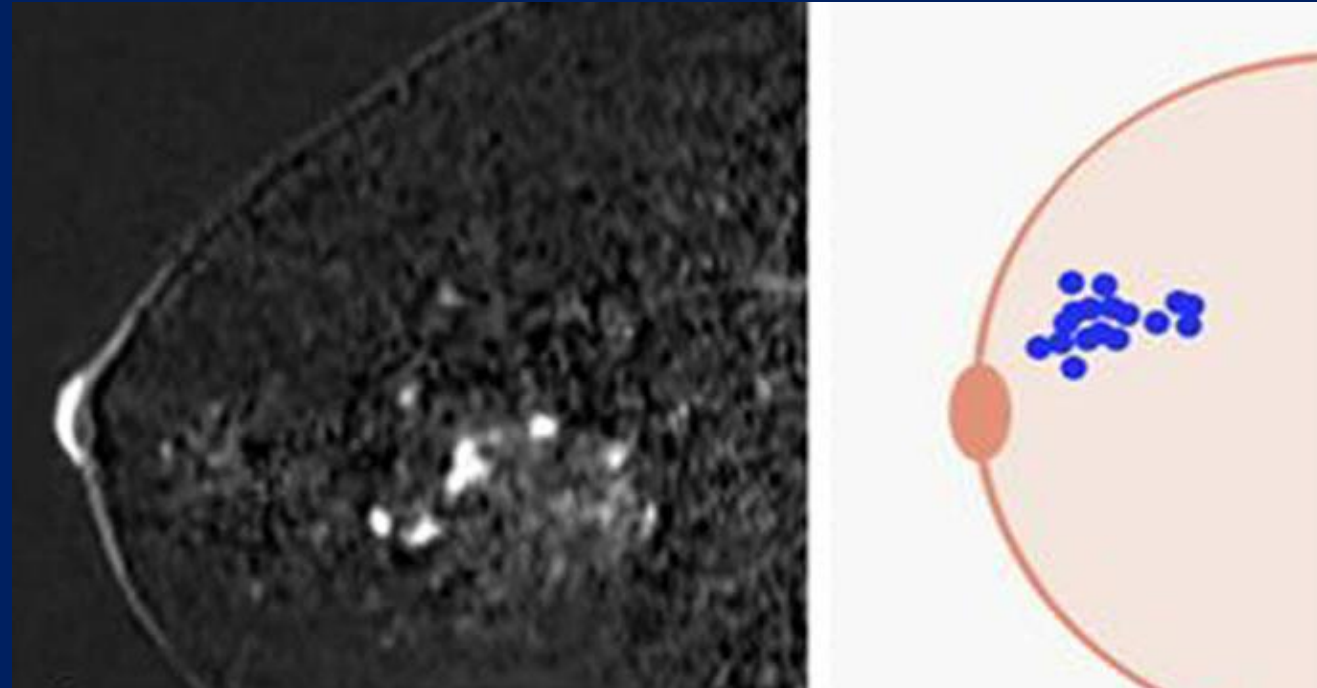
DCIS

Clumped enhancement NME:

small aggregates of enhancement ("cobblestone" like) in various sizes and shapes, suggestive of ductal involvement



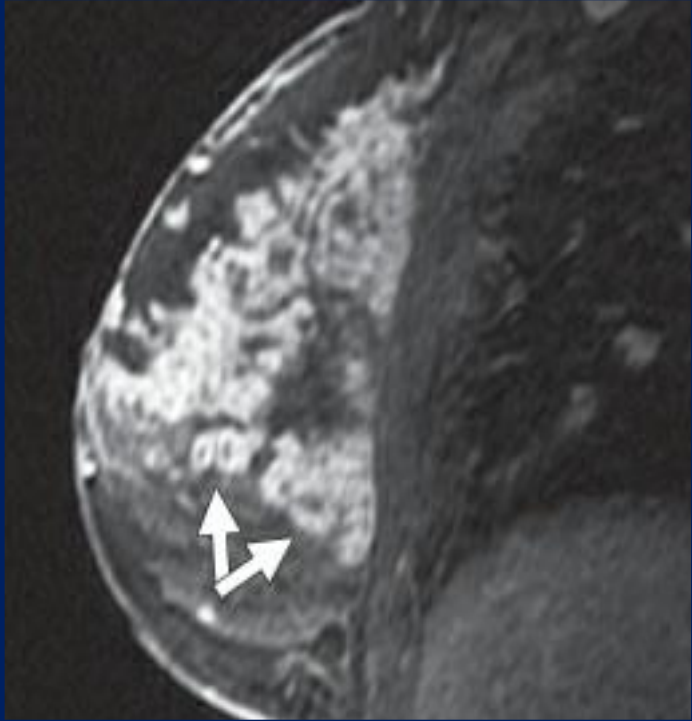
DCIS



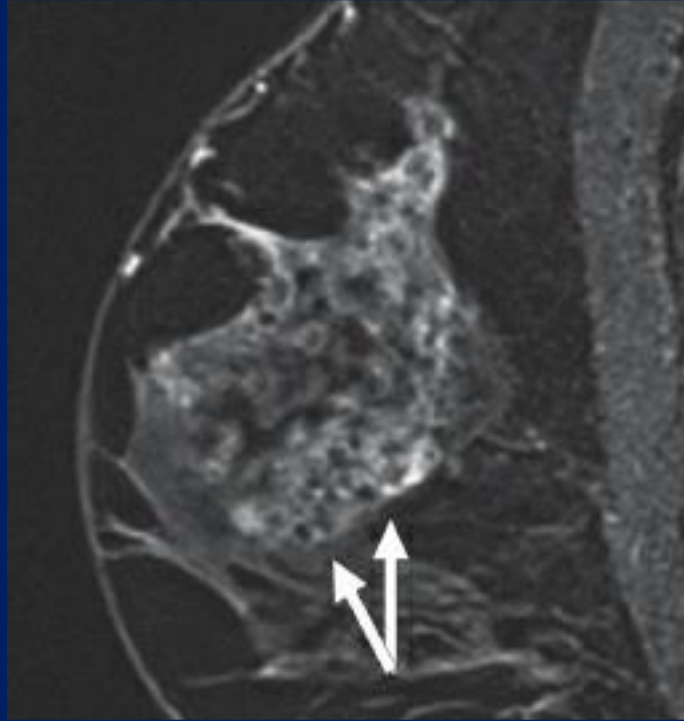
PASH: pseudoangiomatous stromal hyperplasia and fibrosis.

Cluster ring enhancement NME:

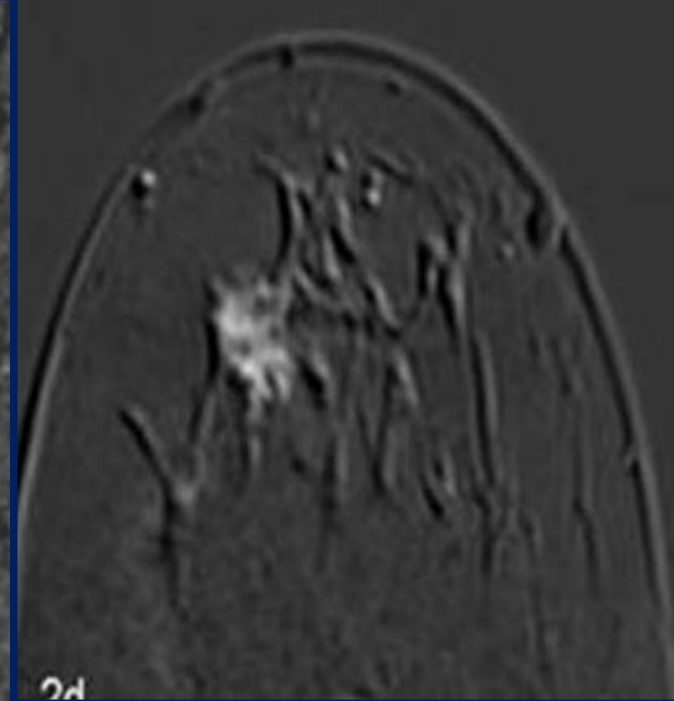
multiple small ring shapes closely arranged, suggestive of periductal involvement



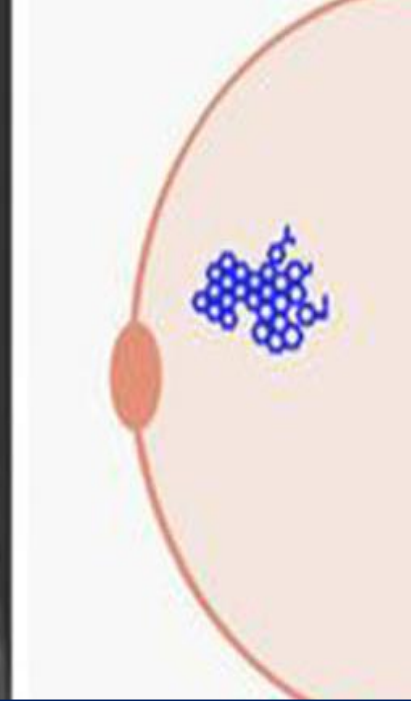
DCIS



DCIS



Invasive lobular carcinoma

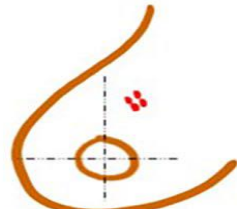


NME characteristics in breast MRI

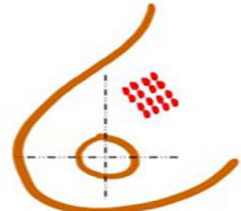
DISTRIBUTION



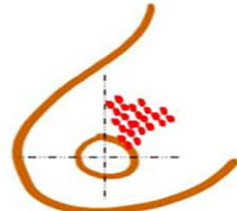
1. LINEAR



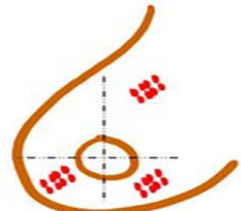
2. FOCAL



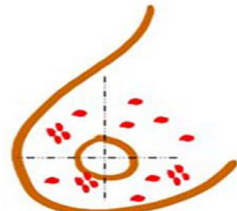
3. REGIONAL



4. SEGMENTAL

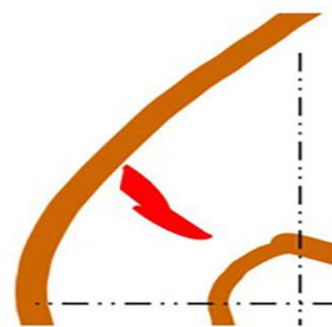


5. MULTIPLE
REGIONS

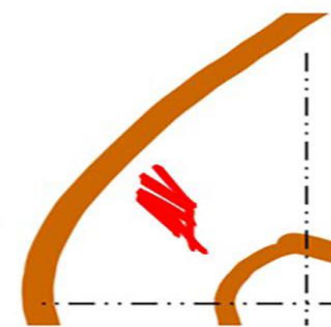


6. DIFFUSE

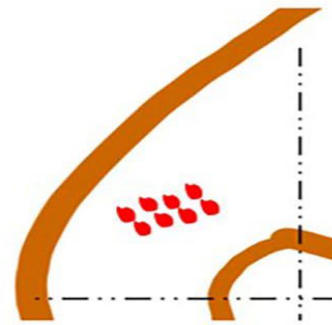
INTERNAL ENHANCEMENT PATTERN



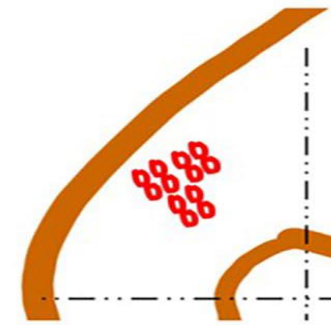
1. HOMOGENEOUS



2. HETEROGENEOUS




3. CLUMPED















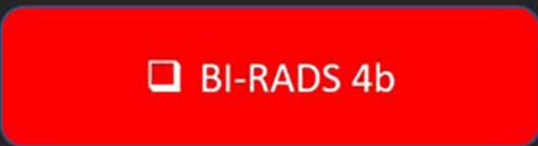
4. CLUSTER RING

Management of Non-Mass Enhancement at Breast Magnetic Resonance in Screening Settings Referred for Magnetic Resonance-Guided Biopsy

Eduardo de Faria Castro Fleury¹ , Caio Castro²,
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DISTRIBUTION (D)	INTERNAL ENHANCEMENT PATTERN (IEP)	ASSOCIATION D ↔ IEP	FINAL ASSESSMENT
<ul style="list-style-type: none"> ➤ Diffuse ➤ Multiple áreas ➤ Linear 	✓ Homogeneous	 + 	 BI-RADS 3
<ul style="list-style-type: none"> ➤ Focal ➤ Regional 	<ul style="list-style-type: none"> ✓ Heterogeneous ✓ Clumped 	 +  	 BI-Rads 4a
<ul style="list-style-type: none"> ➤ Segmental 	✓ Clustered-ring	 +   	 BI-RADS 4b

Grading system to categorize breast MRI using BI-RADS 5th edition: a statistical study of non-mass enhancement descriptors in terms of probability of malignancy

Tatsuno

Received: 1
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	Minor (0 points)	Intermediate (1 point)	Major (2 points)
Internal enhancement	Homogenous	Heterogeneous Clumped	Clustered ring
Distribution	Linear (< 1 cm) ^a (Regional, Multiple, Diffuse) ^b	Focal Linear	Segmental

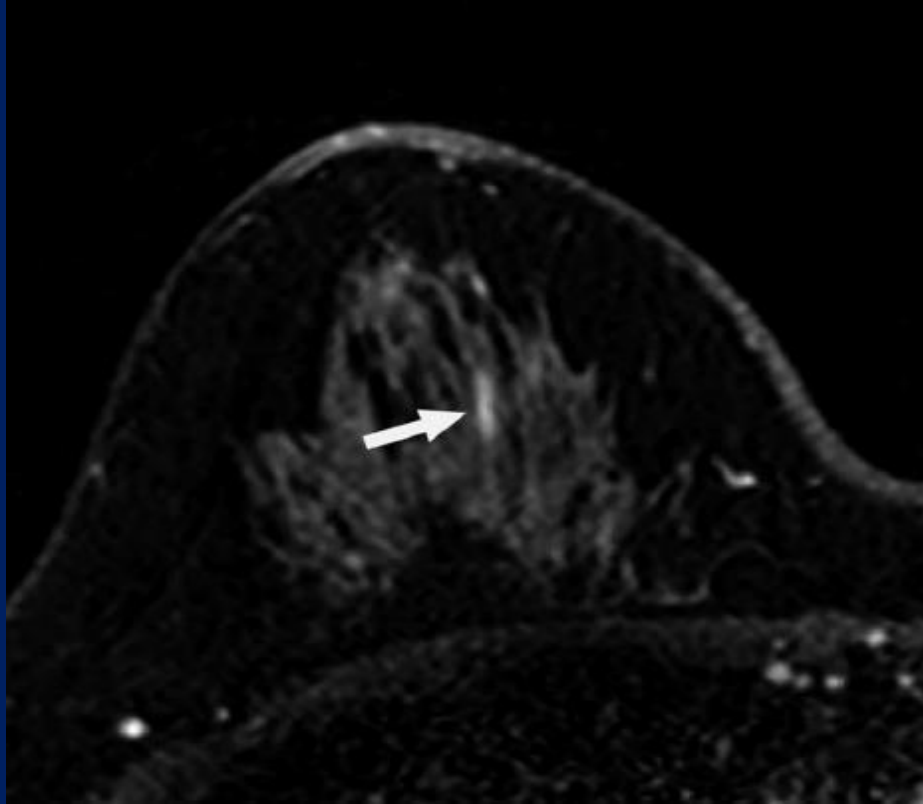
a: Linear (single line) subtype **smaller than 1 cm**. This is **minor** suspicious **regardless of internal enhancement** linear pattern of **1 cm or more**, and a **branching** pattern: were classed as **intermediate (1)**

b: Regional, multiple and diffuse were inconclusive for grades

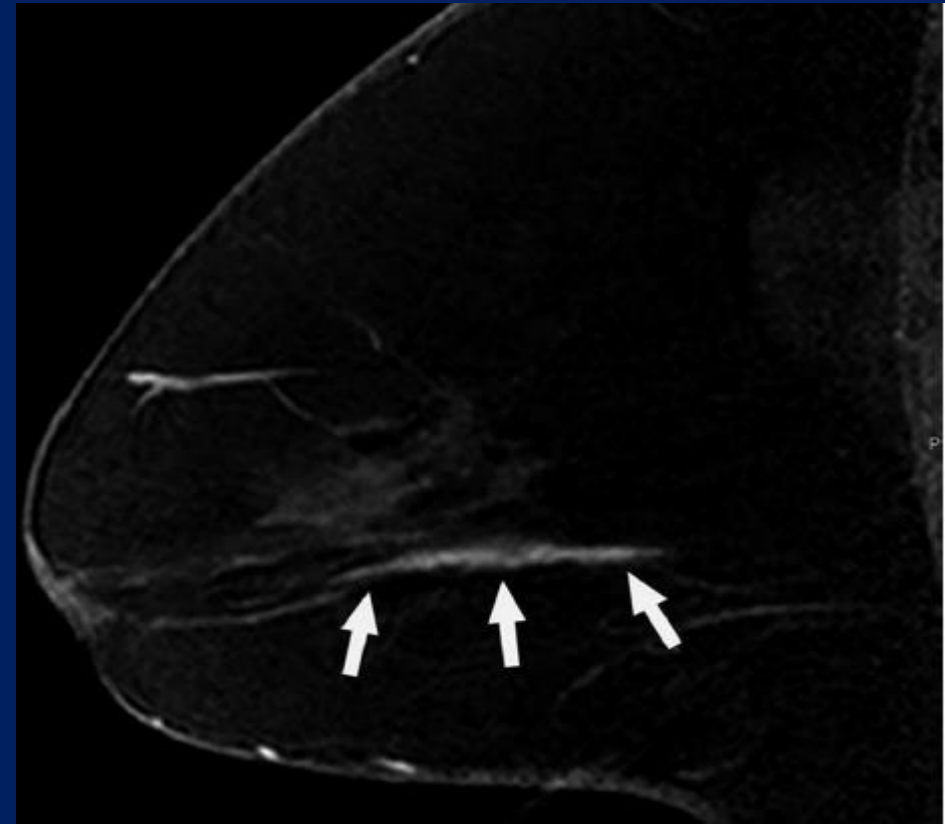
Sum score	Category	Internal enhancement/distribution	Malignant* (n = 178)	Benign* (n = 35)	Total	PPV (%)
4	5	Clustered ring/segmental	106	7	113	93.8
3	4C	Clumped/segmental	15	5	20	81.1
		Heterogeneous/segmental	17	2	19	
		Clustered ring/focal	23	6	9	
		Clustered ring/linear	1	0	1	
2	4B	Clustered ring/others ^a	5	0	5	73.3
		Clumped/focal	2	0	2	
		Heterogeneous/focal	0	2	2	
		Heterogeneous/linear	4	2	6	
1	4A	Clumped/others ^a	3	0	3	55.6
		Homogeneous/focal	0	3	3	
		Homogeneous/linear	2	1	3	
0	3	Homogeneous/others ^a	0	1	1	0
		Any/linear < 1 cm	0	6	6	

^aOthers include regional, diffuse and multiple distributions

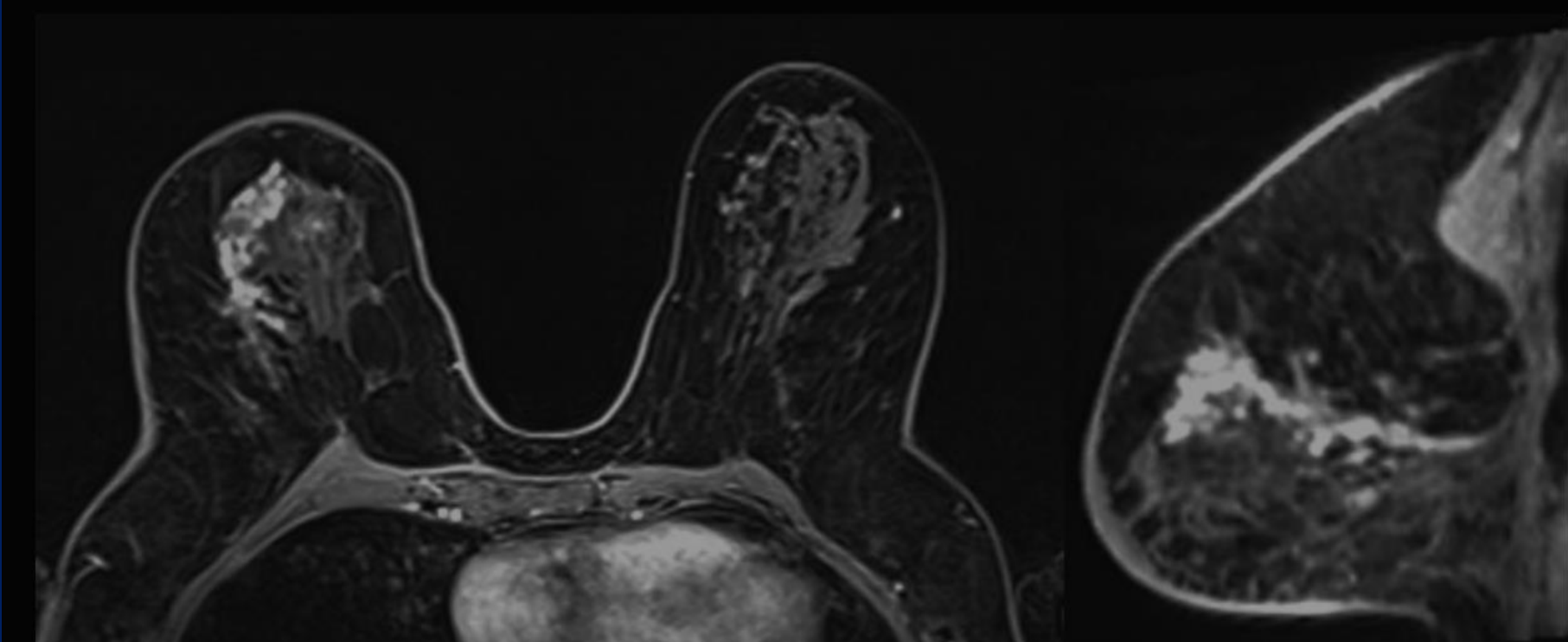
The probabilities of categories showed a significant difference (Fischer's exact test; $p < 0.0001$)



A 52-year-old woman with NME
 linear distribution(0.9 cm) with homogeneous
 enhancement (0 points) classed as
category 3, no malignancy has occurred in 4-year
 follow-up study



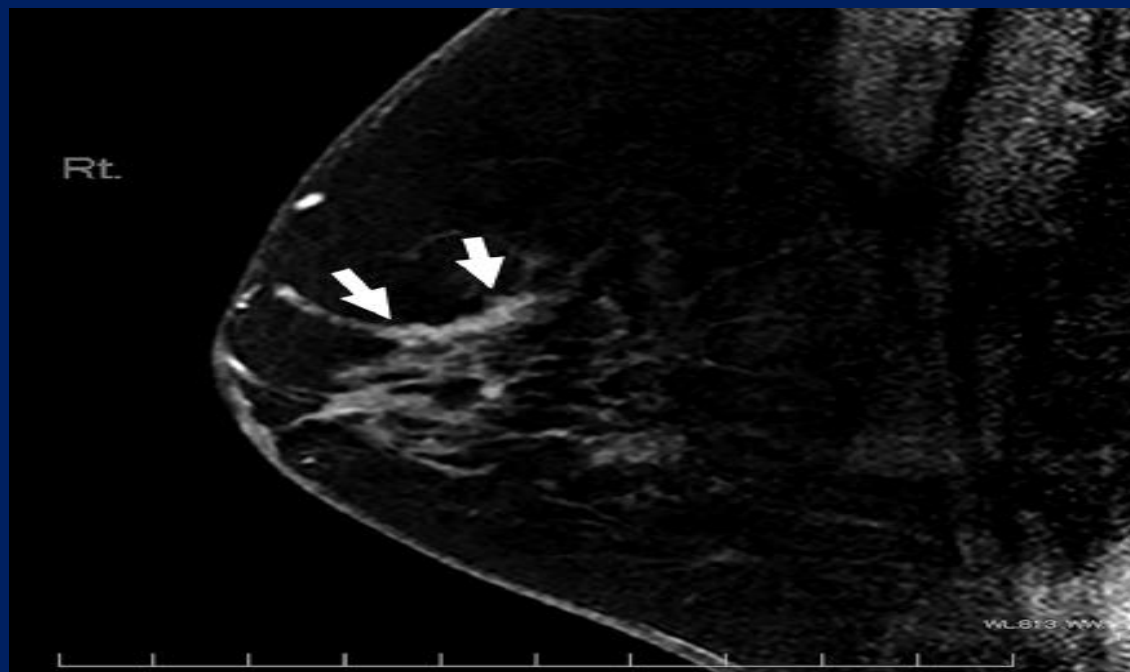
An 80-year-old woman with Sagittal
 T1 fat-saturated dynamic MR image shows linear
 distribution(3.3 cm) (1 point) with homogeneous
 enhancement: **B4**
 DCIS



Linear branching NME with clumped enhancement: 2point, B4
Lobular Carcinoma

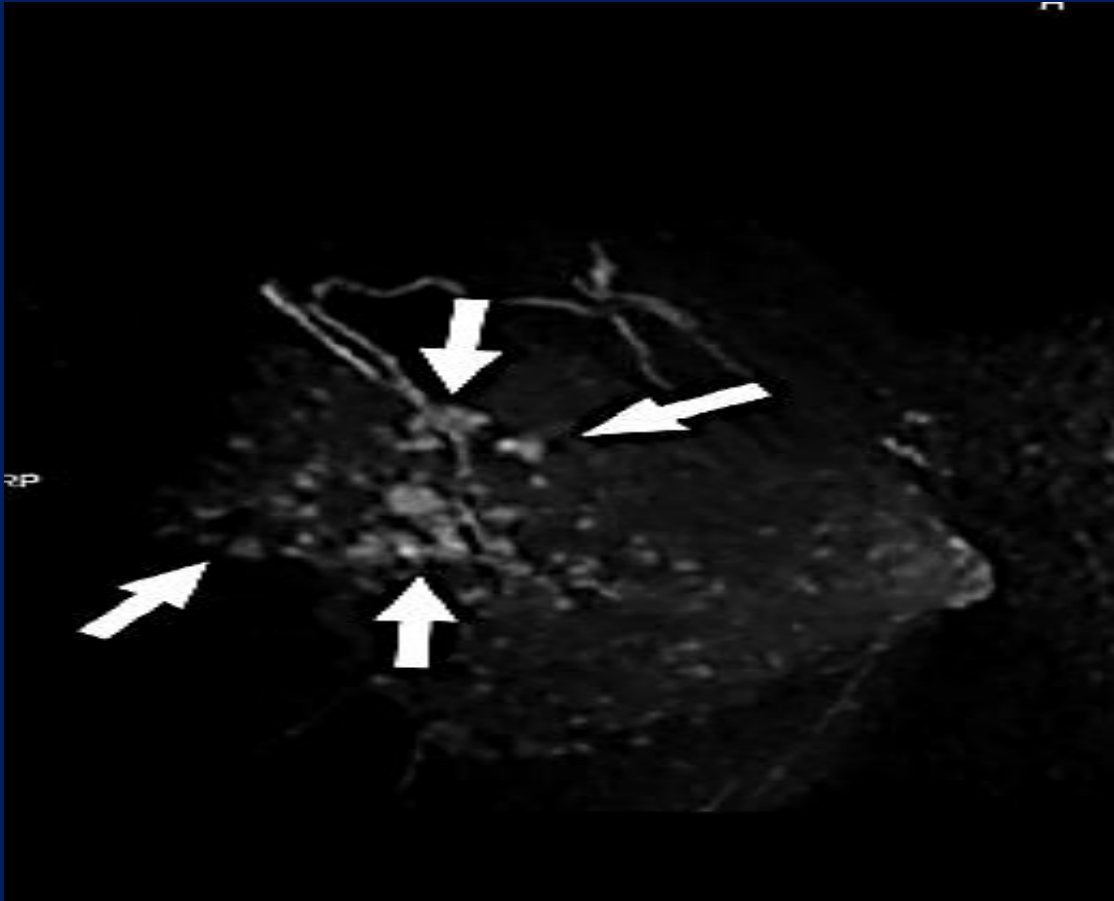


44y/o Transverse T1 fat-saturated:
focal NME (1 point) with **homogeneous**
 enhancement (0 points)= (1 point).
No histological examination was performed;
 however,
 the **2-year follow-up** study has shown no signs
 of abnormalities.
 The lesion was regarded as being **benign**.

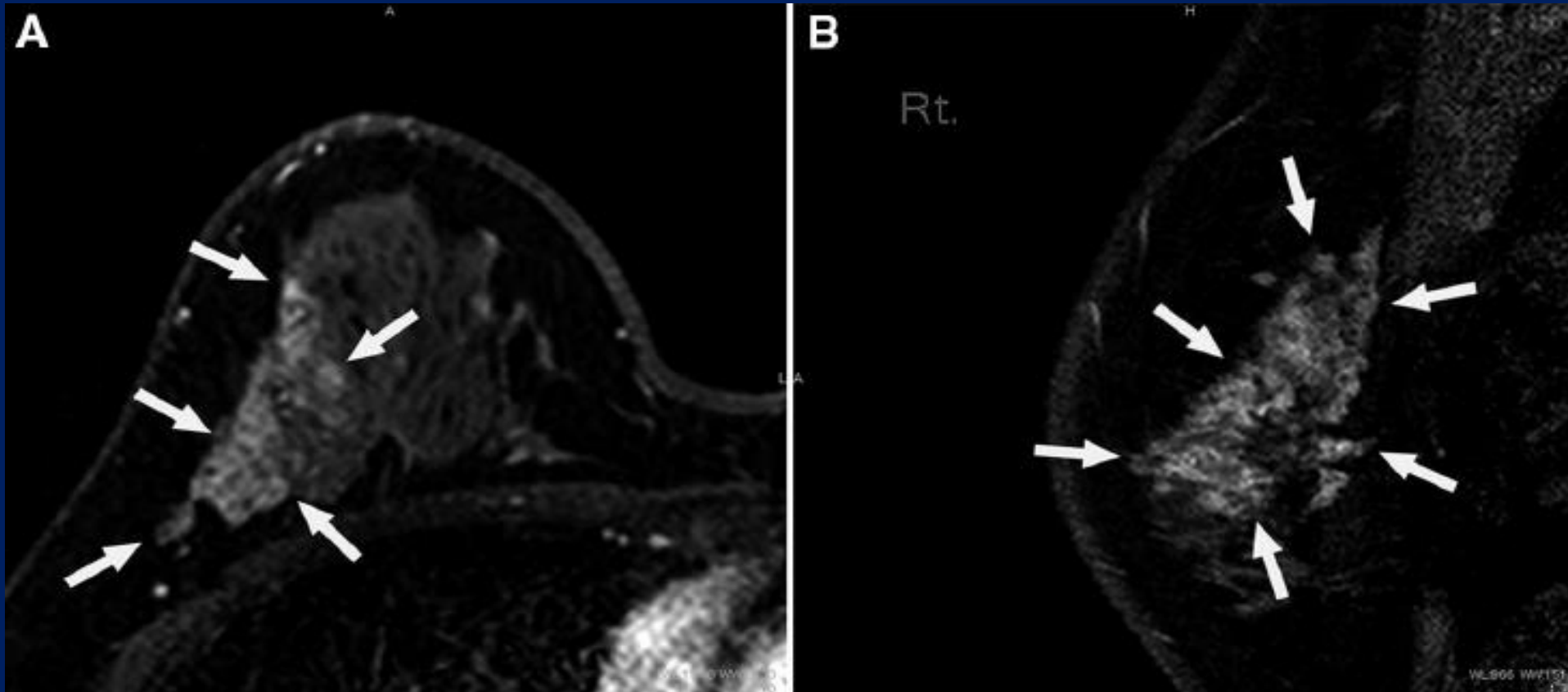


63y/o Sagittal T1 fat-saturated dynamic MR image shows
linear distribution (1.6 cm) (1 point) with
heterogeneous enhancement(1 point)

category 4 (2 points).
DCIS



45-year-old woman
MIP image of fat-saturated dynamic MRI shows
segmental NME (2 points) with clumped
enhancement (1 point)
category 4 (3 points): tubular carcinoma.



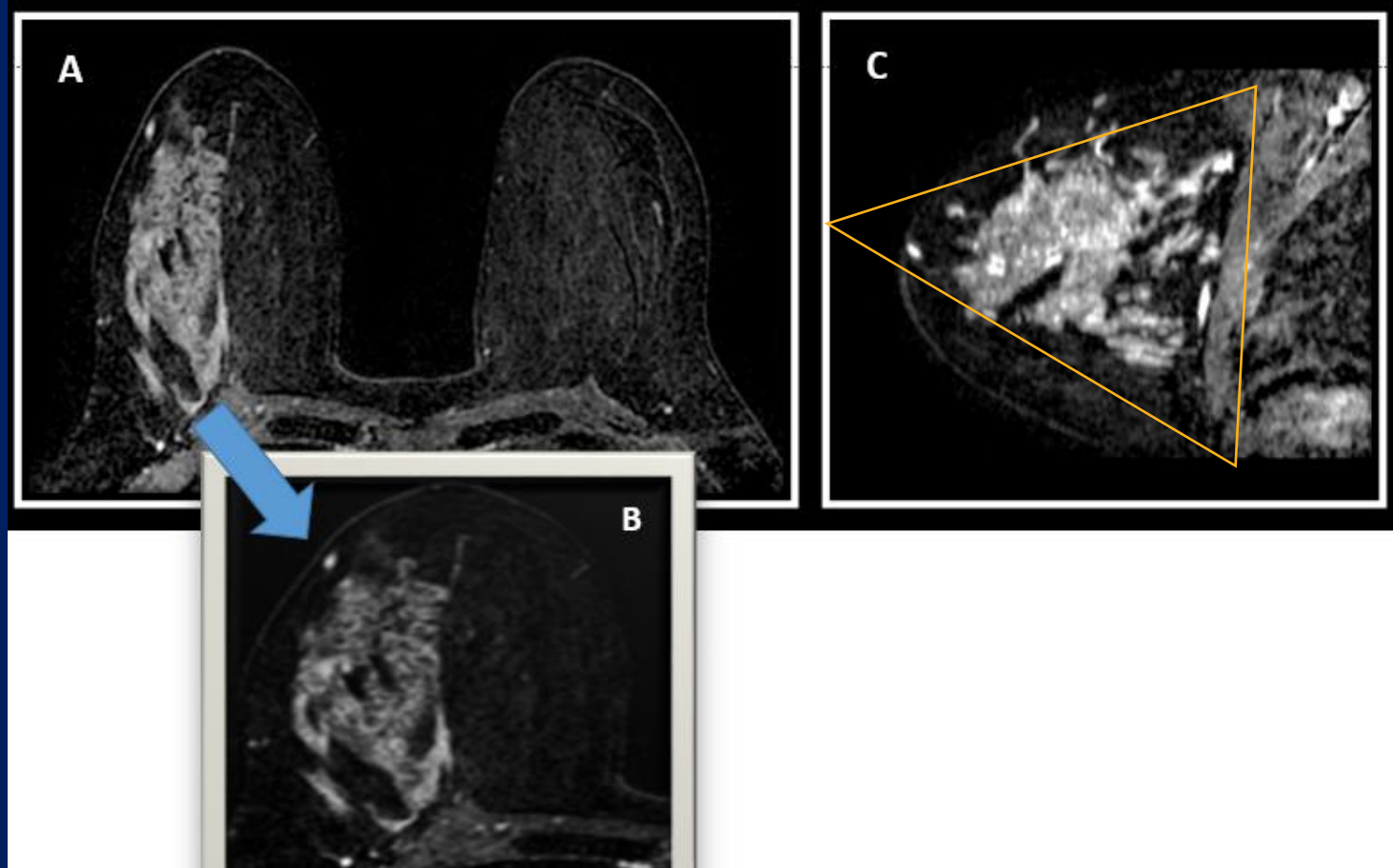
49y Transverse T1 fat-saturated :
segmental NME (2 points) with clustered ring enhancement (2 points):
4point

DCIS

Our study

Segmental distribution and **clustered-ring** enhancement are the **most predictors** for **malignancy** in NME cases

Descriptor	Malignant (n=18) (%)	Benign (n=45) (%)	P value
Kinetic curve			
Persistent	3 (16.7)	45 (100)	0.0001
Plateau	10 (55.5)	0 (0.0)	0.0001
Washout	5 (27.8)	0 (0.0)	0.0001
Diffusion restriction			
Present	16 (89)	2 (11.1)	0.0001
Absent	2 (11)	43 (95.6)	



a 35 year-old female show clustered ring non-mass enhancement with segmental distribution in right breast.
biopsy result was invasive ductal carcinoma.

Invasive or Non invasive

- **clustered-ring enhancement** was significantly associated with **invasion** and was more commonly observed in **microinvasive** ductal carcinoma than in pure DCIS
- **wash-out curve, type 3 dynamic curve** could help identify **invasive NME** from carcinoma in situ cases
- **ADC** value of **invasive** carcinoma ($0.933 \times 10^{-3} \text{mm}^2/\text{s}$) was statistically **lower** than that of carcinoma *in situ* ($1.13 \times 10^{-3} \text{mm}^2/\text{s}$) and **restricted diffusion** on DWI were **statistically** different between invasive cancer and DCIS ($P < 0.05$)

Ann Transl Med. 2022 Mar; 10(6): 357.

doi: [10.21037/atm-22-503](https://doi.org/10.21037/atm-22-503)

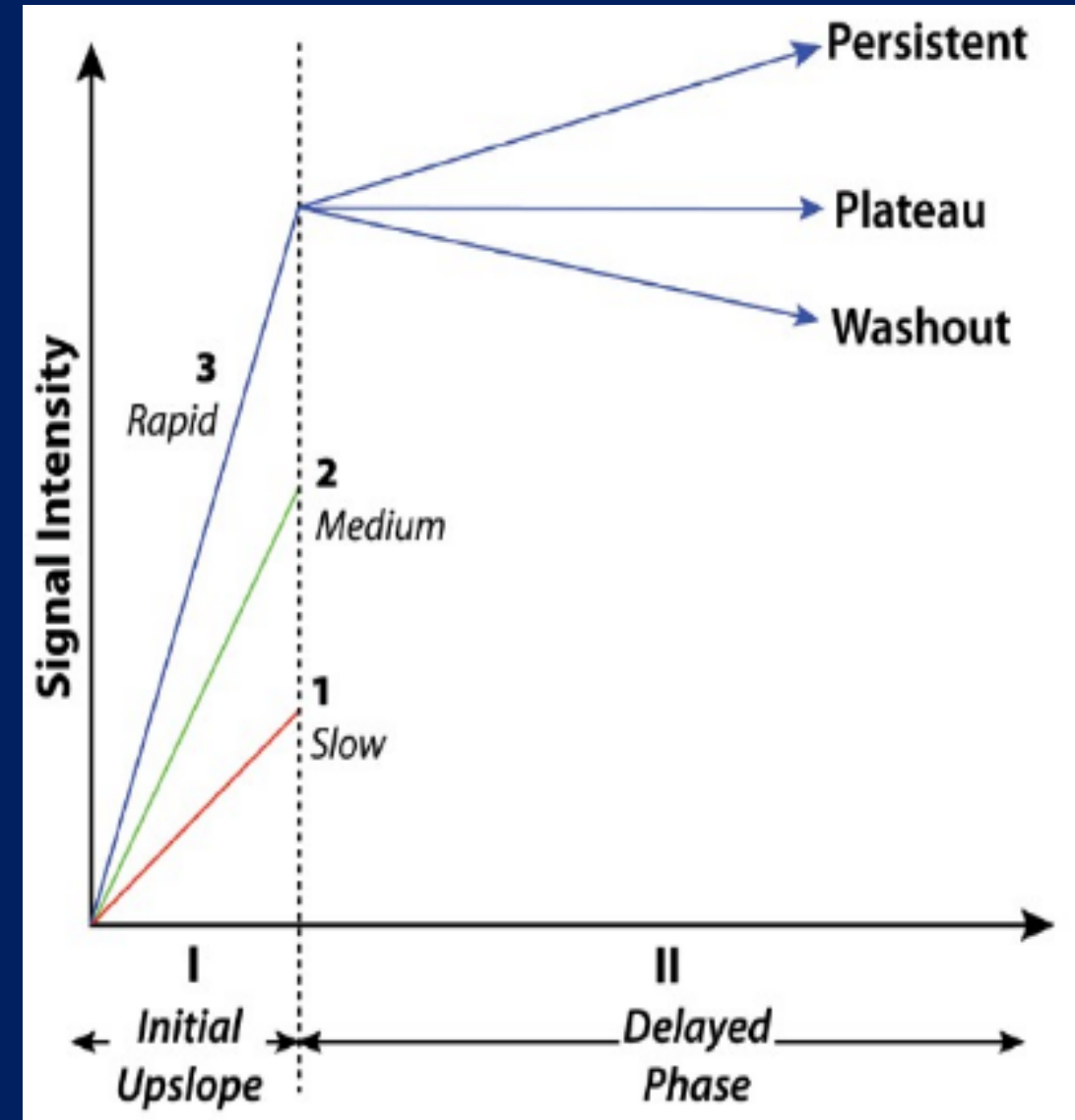
PMCID: PMC9011203

PMID: [35433999](https://pubmed.ncbi.nlm.nih.gov/35433999/)

Non-mass enhancement breast lesions: MRI findings and associations with malignancy

Gang Liu,^{✉ #1, #^} Ying Li,^{#1, #} Si-Lu Chen,^{1, 2} and Qiao Chen¹

- Initial rise descriptors: within first 2 min
 - ○ Slow
 - ○ Medium
 - ○ Rapid
 - ■ Malignancy is typically characterized by rapid initial rise
- • Delayed phase: after first 2 min, or when curve changes
 - ○ Persistent: “type I” curve, >10% increase; 6% risk of malignancy
 - ○ Plateau: “type II” curve, $\leq 10\%$ change; 64% risk of malignancy
 - ○ Washout: “type III” curve, >10% decrease; 87% risk of malignancy



- Both DCIS and invasive cancers may have variable kinetic features
- Further, benign NME may have suspicious kinetic features, including rapid early enhancement or plateau or washout patterns
- Hence, in interpretation of NME, morphologic characteristics should take precedence over the kinetic features in the BI-RADS assessment and clinical management.

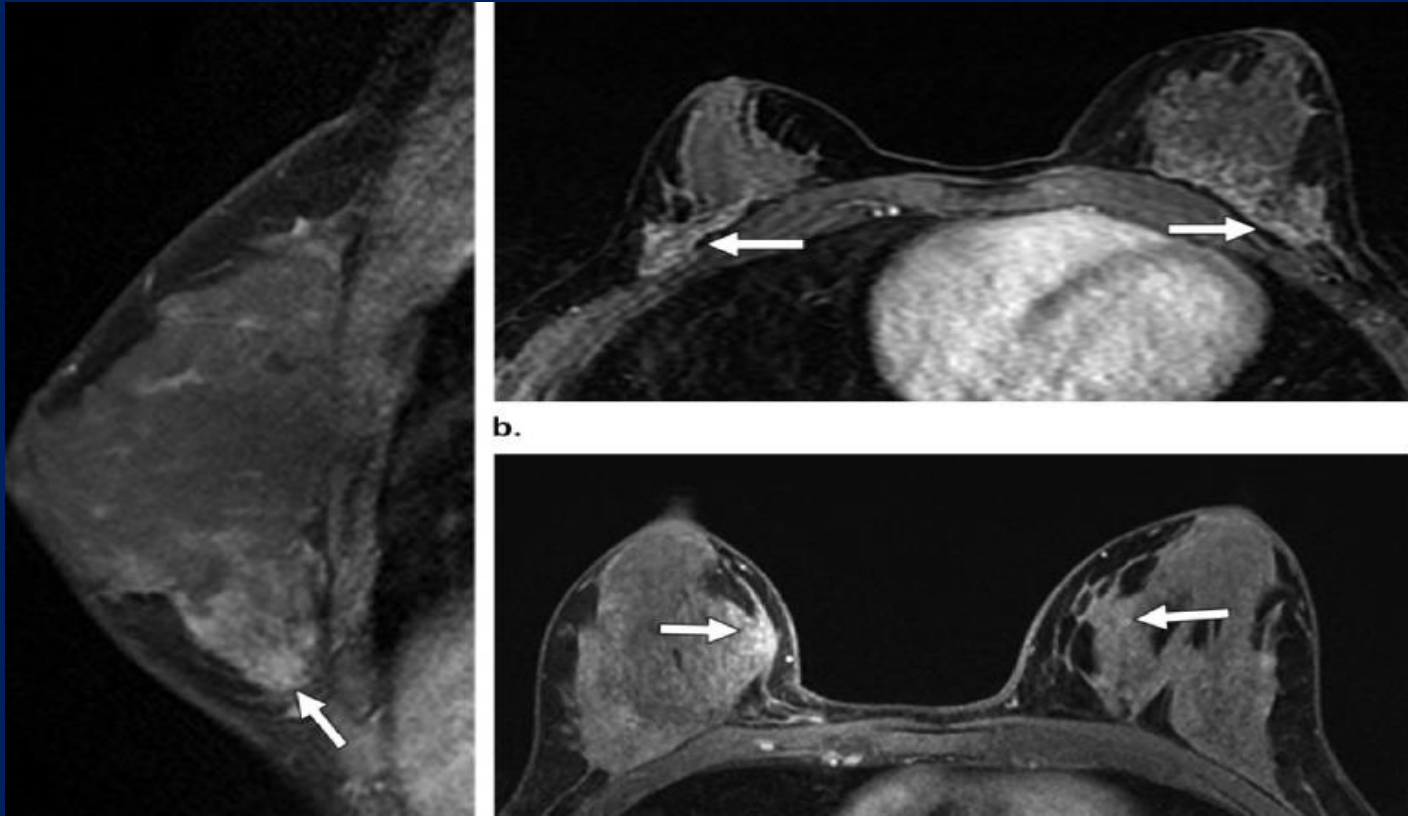
- For **slowly** and **persistently** enhancing **NME**, **delayed images** may be **more useful** for lesion **detection** and **analysis** than early dynamic images
- Conversely, in setting of **diffuse background enhancement**, **focal NME** may be **much less conspicuous** on **delayed** images than on **early dynamic** images **because of the increased background enhancement with time.**

- wide range of PPV results
- however for focal and regional distribution, PPV were lower than that of segmental distribution
- clustered-ring , clumped enhancement: most PPV

DDx: Asymmetric BPE

- BPE is evaluated in the **early** contrast phase and classified into four levels: **minimal, mild, moderate, and marked**
- Kinetic curves in BPE: **slow early** enhancement **with persistent mild delayed** enhancement
- **distribution** may manifest **as multiple foci** of enhancement or **diffuse, more homogeneous** regions of enhancement.
- Healthy tissue in the **lateral, medial, and posterior-inferior** portions of the breast **commonly** enhances from peripheral to **central** areas, in a type of “**picture-frame**” pattern

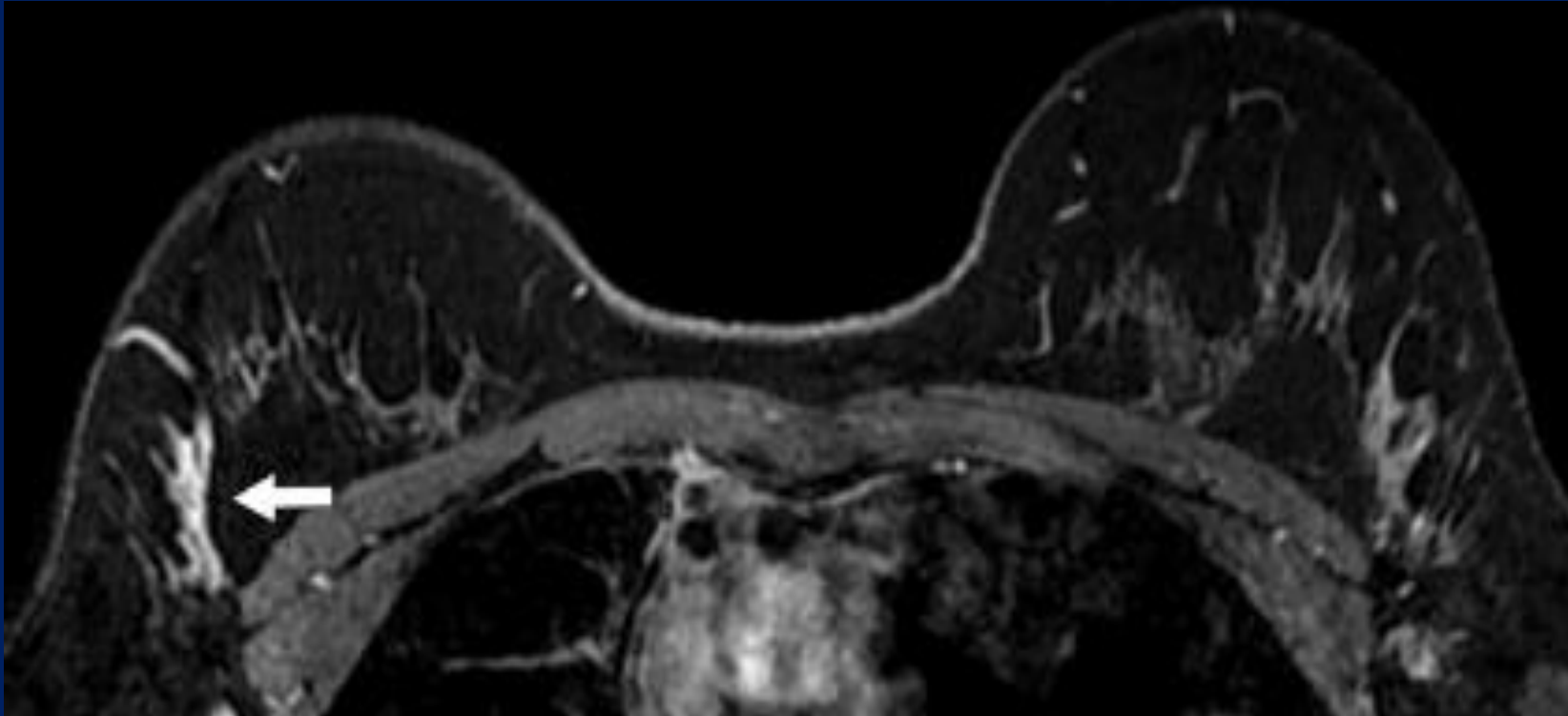
“Picture framing,” or normal enhancement from peripheral to central areas, in three different women who underwent screening MR imaging.



B: **symmetric peripheral axillary tail** and **posterior** enhancement (arrows).

C: **peripheral** enhancement (arrows) in the **medial** portion of each breast, with **greater** enhancement in right breast than in the left

A: Sagittal delayed contrast-enhanced T1-weighted fat-suppressed MR image : **peripheral** enhancement (arrow) in the **posterior lower** portion of the breast.



Screening examination , Similar
benign parenchymal enhancement (BPE)

- **screening** breast MR imaging should be scheduled **during the 2nd week of the menstrual cycle, or days 7–15,** to minimize background enhancement and **potential false-positive** interpretation.
- **Multiple similar** regions of enhancement, in **focal,** or **regional** distribution , are more characteristic of **benign** proliferative changes or **hormonally mediated** background enhancement
- In nonsurgical (i.e., **screening**) cases: **BI-RADS 3** assessment, **6-month follow-up** MR imaging



Pathologic category of NME lesions

Category	No.
Malignant	56
Ductal carcinoma <i>in situ</i>	32
Invasive ductal carcinoma	24
Benign	62
Adenosis	14
Fibroadenoma	8
Intraductal papilloma	24
Inflammation	16

High risk lesions:

- ❖ Atypical Ductal Hyperplasia(ADH)
- ❖ Radial Scar and Complex Sclerosing Lesion
- ❖ Flat Epithelial Atypia
- ❖ Intraductal Papilloma

Summarize breast MRI using BI-RADS 5th edition: mass enhancement descriptors in terms of malignancy

Yoshihide Kanemaki² · Keishi Fujiwara³ · Satoko Okamoto² · Yasuo Nakajima³

September 2017

Malignant	N = 178	Benign	N = 29
Ductal carcinoma in situ	87	Intraductal papilloma	4
Invasive ductal carcinoma	69	Mastopathy	6
Invasive lobular carcinoma	6	Fibroadenoma	2
Mucinous carcinoma	6	Peripheral papilloma	1
Tubular carcinoma	4	Normal breast tissue	1
Apocrine carcinoma	2	Mastitis	1
Invasive micropapillary carcinoma	2	Non-specific diagnosis	14
Paget's disease	1		
Glycogen-rich clear cell carcinoma	1		

- The most common malignancy diagnosed as NME are DCIS, low-grade IDC
- benign : fibrocystic changes and fibroadenosis.

- Cysts within an area of NME have been reported to be indicative of fibrocystic mastopathy
- Reliance on T2 signal as a benign feature may be misleading, because one-third of malignancies had High T2 signal.

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ADVANCED SEARCH

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Original Research | Women's Imaging | August 23, 2017

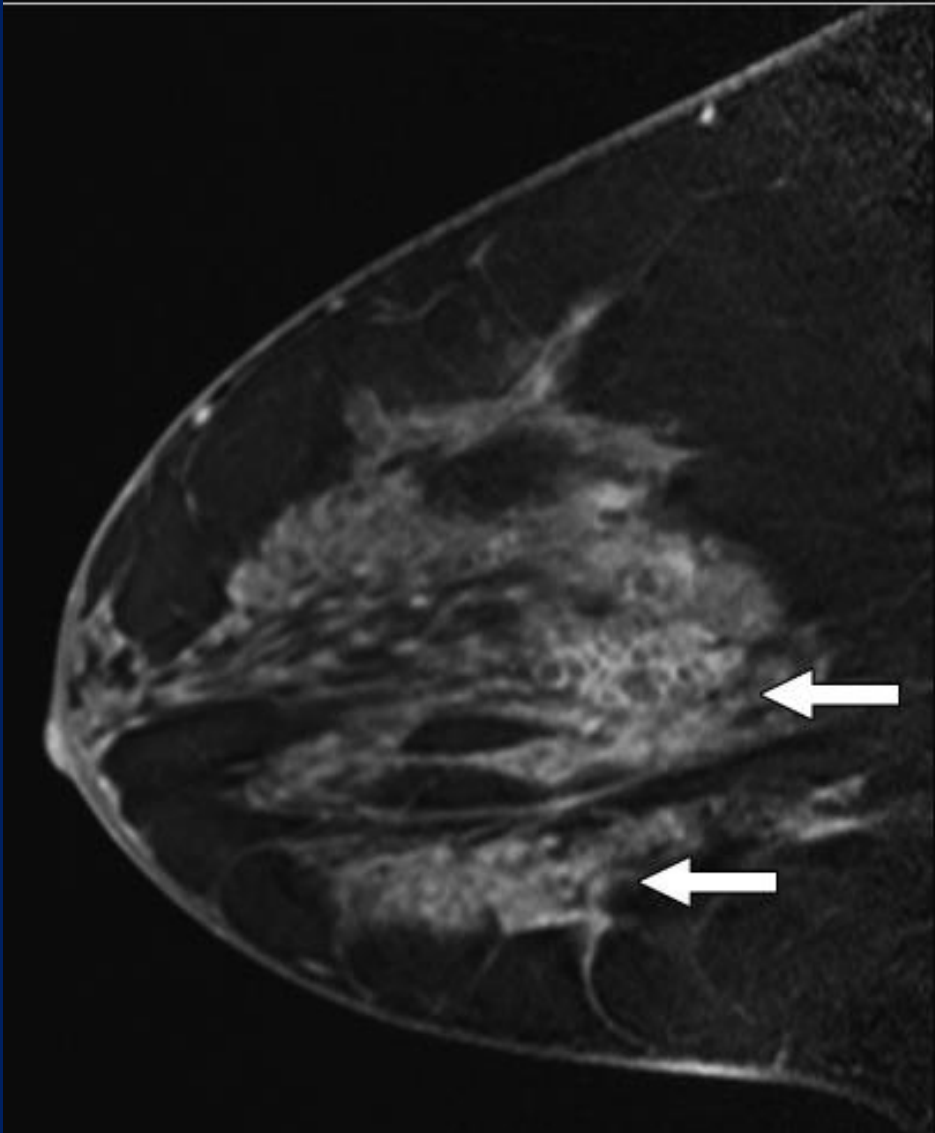
Revisiting Nonmass Enhancement in Breast MRI: Analysis of Outcomes and Follow-Up Using the Updated BI-RADS Atlas

Management of NME

- ❖ NME with clustered-ring enhancement patterns and segmental distribution as BI-RADS 4/ suspicious: referred for percutaneous biopsy even when the second-look evaluation was negative.
- ❖ Linear <1cm, multiple regional and diffuse distribution with homogeneous internal enhancement pattern and negative second look evaluation are classified as BI-RADS 3.
- ❖ lesions classified with the other descriptors referred for a second-look evaluation by ultrasound scan and mammography: if second look was negative: 6-month follow-up as an alternative for the biopsy.
- ❖ When lesion is stable at follow-up, we recommend additional follow-ups of another 6 months and 1 year.
- ❖ when lesion progresses, regardless of the second-look result: biopsy (new second-look evaluation)

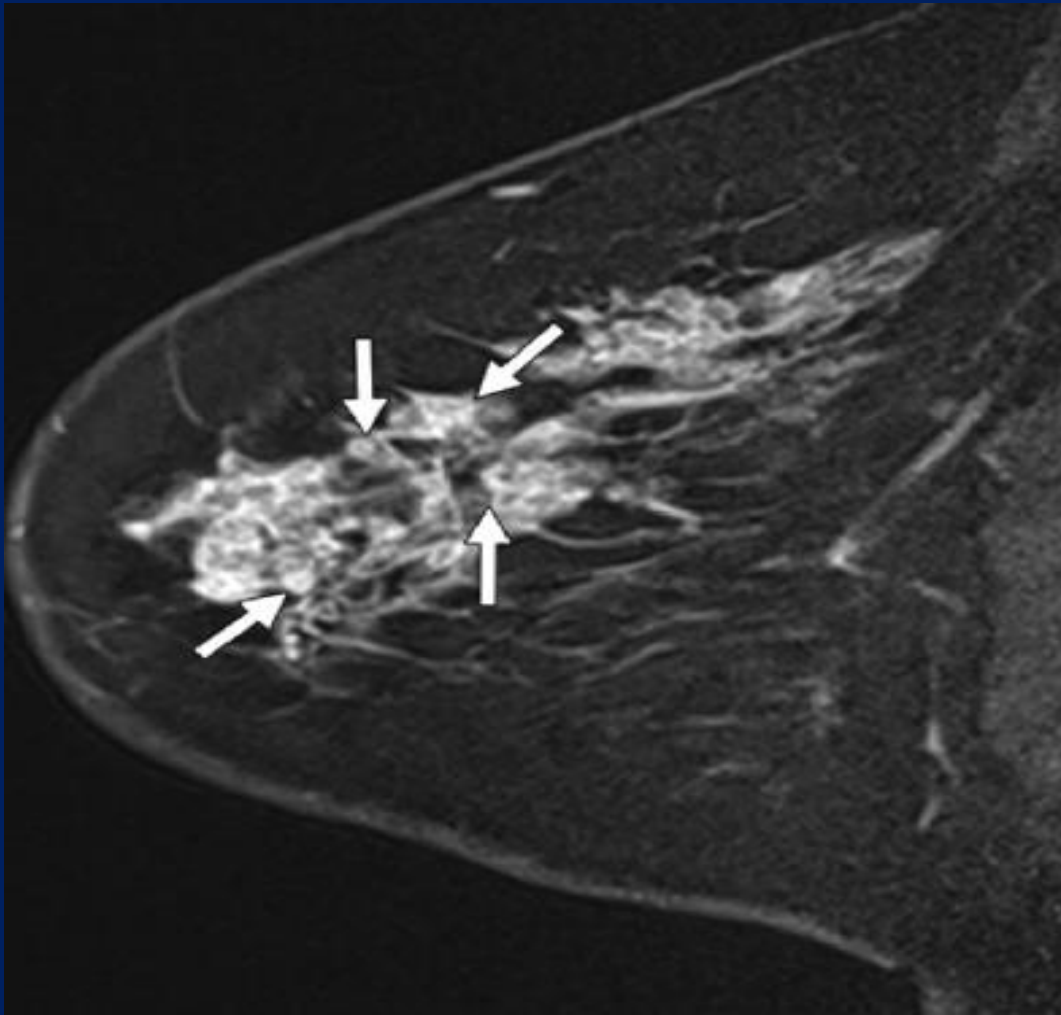
Management of NME

- The best **alternative** for **MRI-guided biopsy** is when the lesion is present in a **second-look evaluation by ultrasound scan or mammography**
- An option in cases when we **cannot** complete the **biopsy** is a **short-time follow-up (6 months)**
- These lesions commonly pertain to **low-aggressiveness** tumors
- The **indolent** characteristic of the NME concedes **a secure 6-month** follow-up for non-biopsied lesions.



segmental clustered ring enhancement

high-grade ductal carcinoma



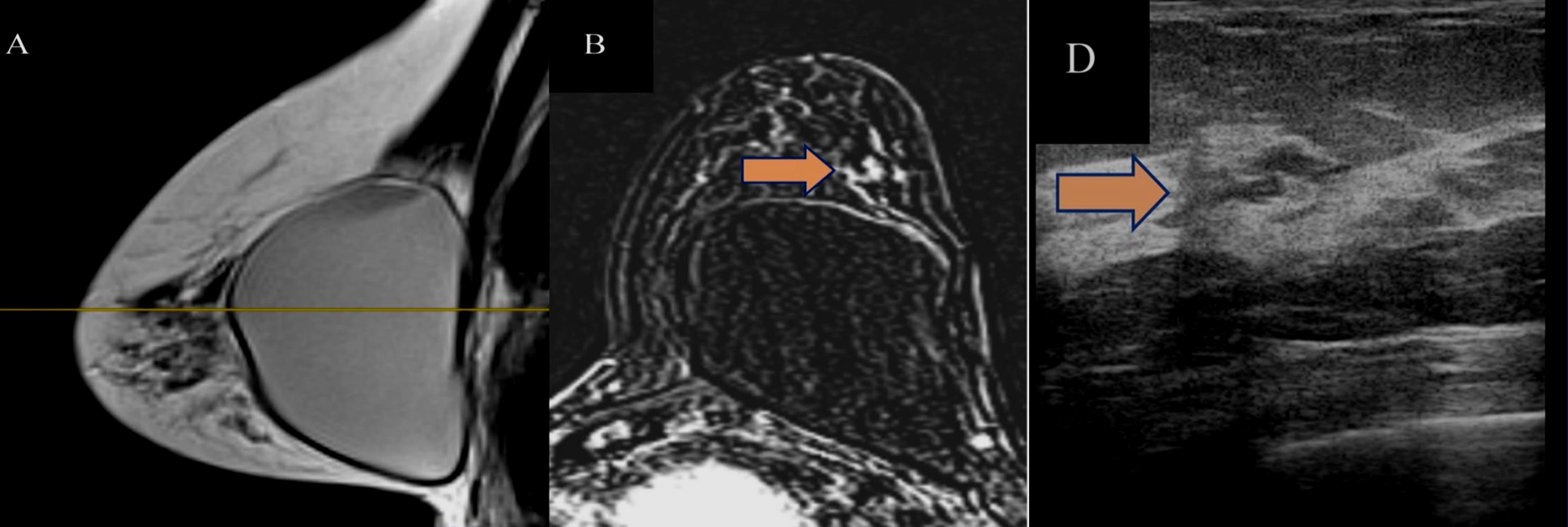
Segmental NME with clustered ring enhancement

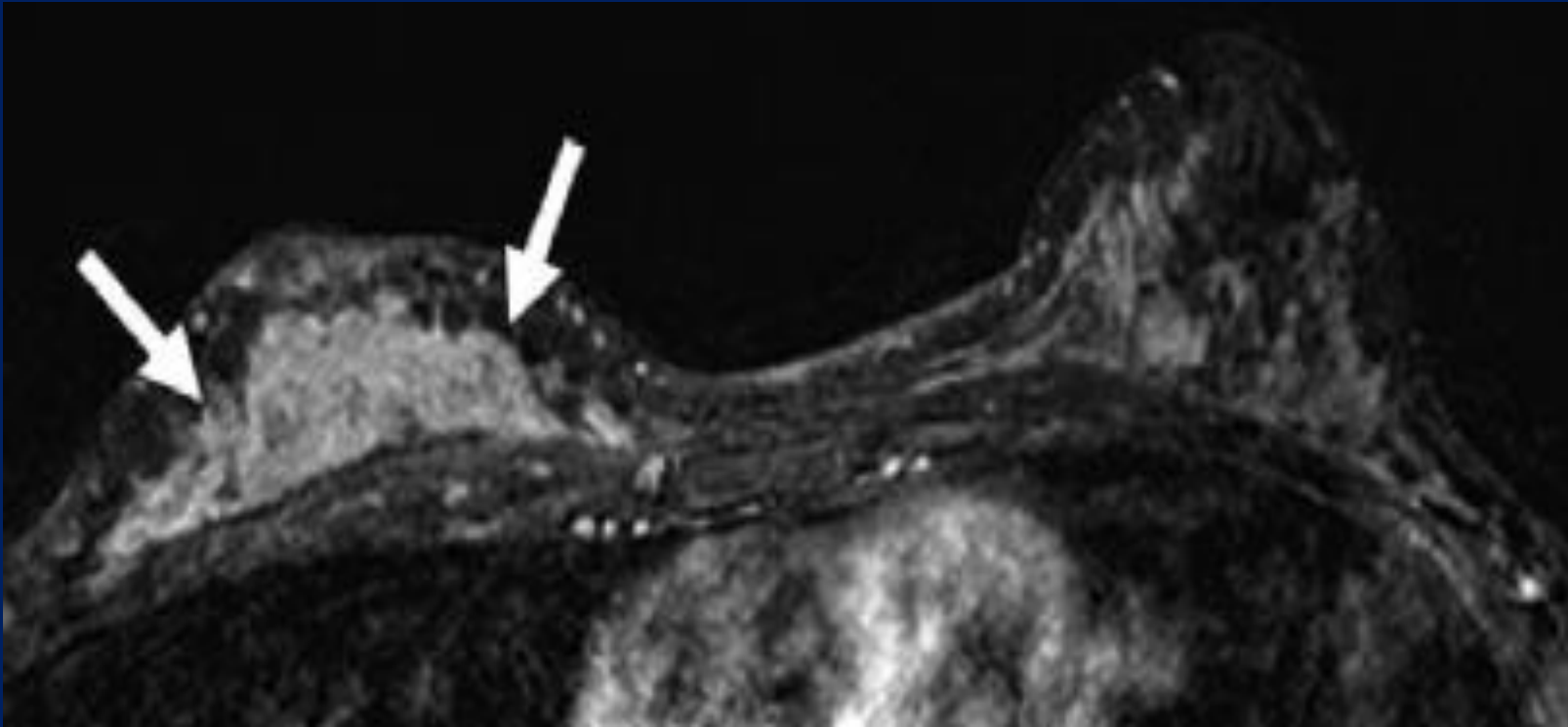
low- to intermediate-grade DCIS

Screening MRI in a 45 year-old woman with breast implants.

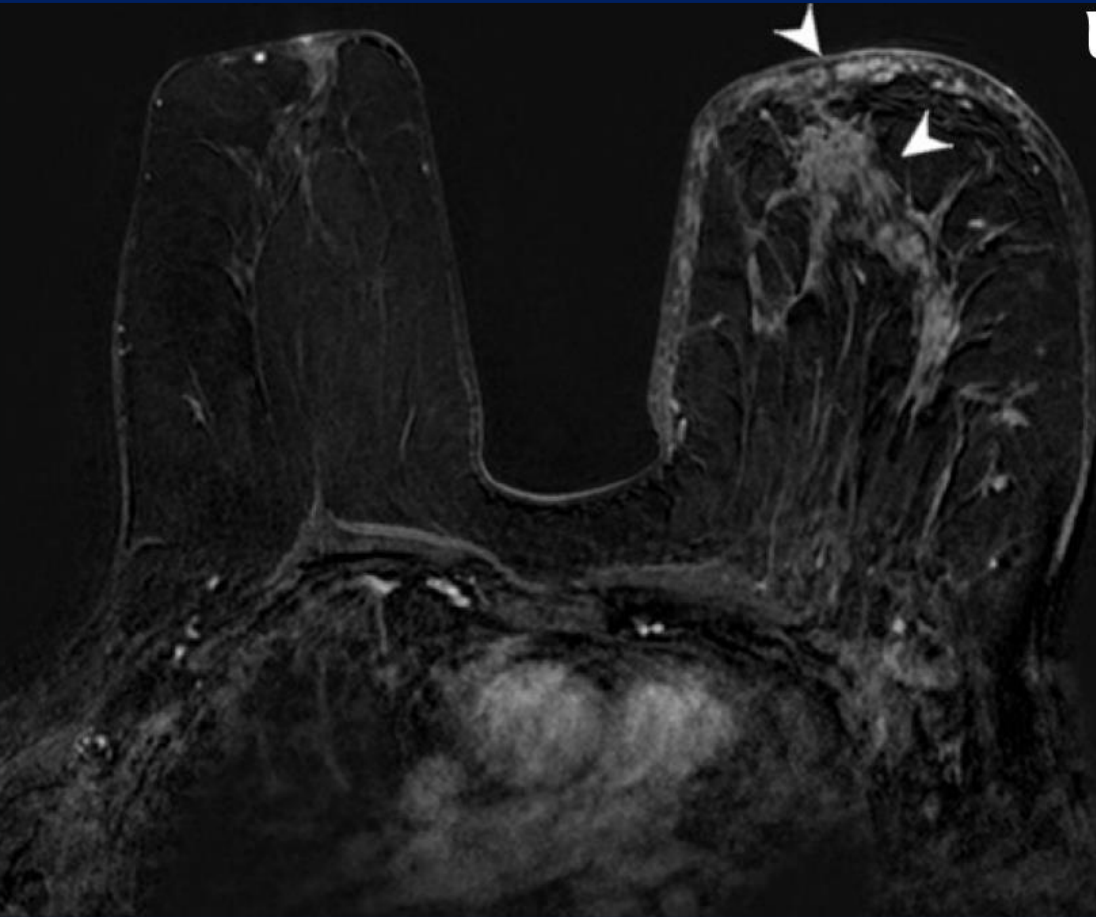
focal and **heterogeneous NME** (orange arrow).

The biopsy was performed guided by a **second-look ultrasound**
biopsy was an **invasive ductal carcinoma**





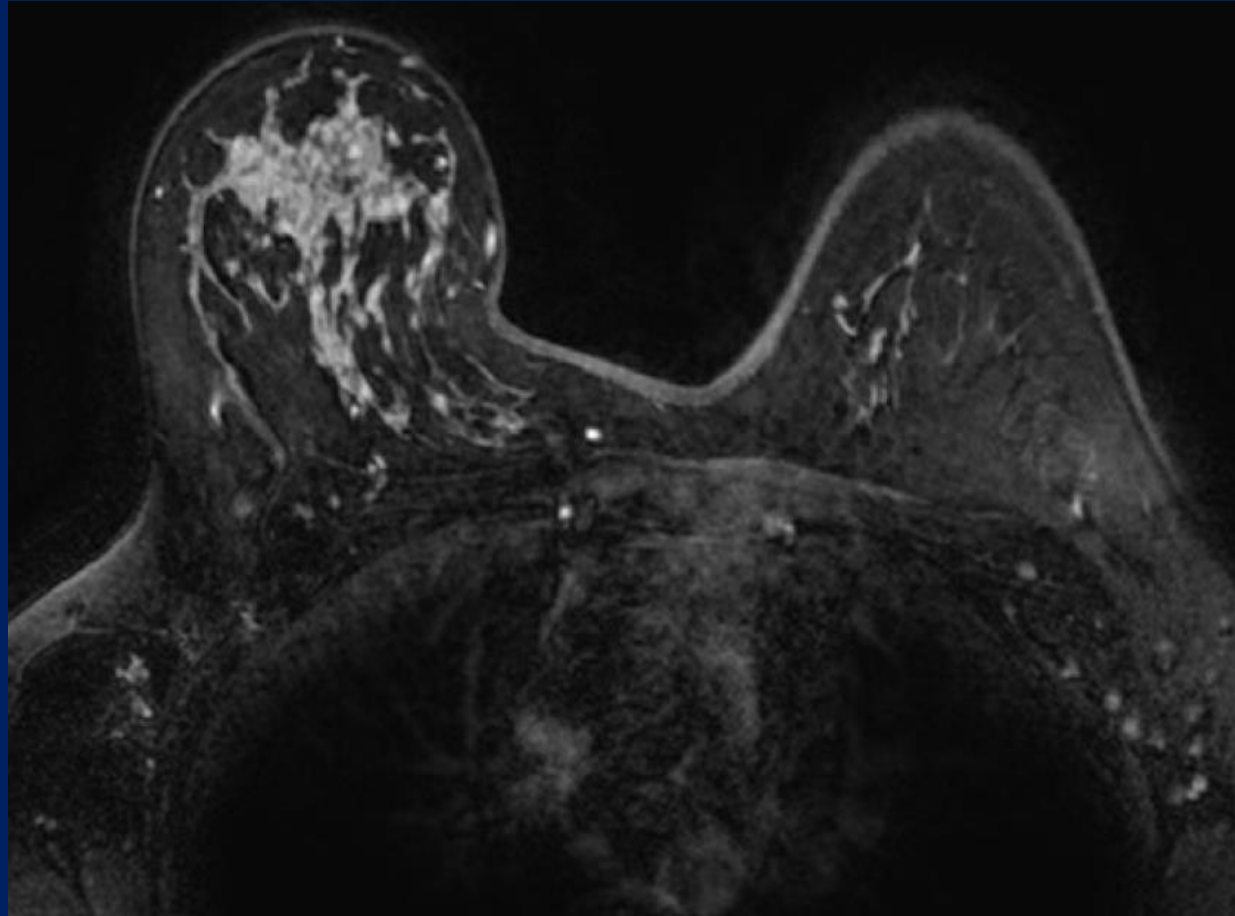
presented with a **firm right breast and flattening of the right nipple**. Axial dynamic contrast-enhanced T1-weighted fat-suppressed MR image shows **diffuse asymmetric nonmasslike** enhancement (arrows) in the right breast, with **heterogeneous** internal enhancement
diffuse invasive ductal cancer



A 79-year-old female
Contrast-enhanced breast MRI shows **NME** with **segmental** type distribution and **heterogeneous** contrast enhancement of **skin**

Clinical: **diffuse hyperemia and peau d'orange** findings of the breast.

Core biopsy : **malignant** epithelial lesion.



A 32-year-old patient with palpable mass and bloody nipple discharge.
diffuse distribution Heterogeneous NME

biopsy showed **DCIS and invasive ductal carcinoma.**

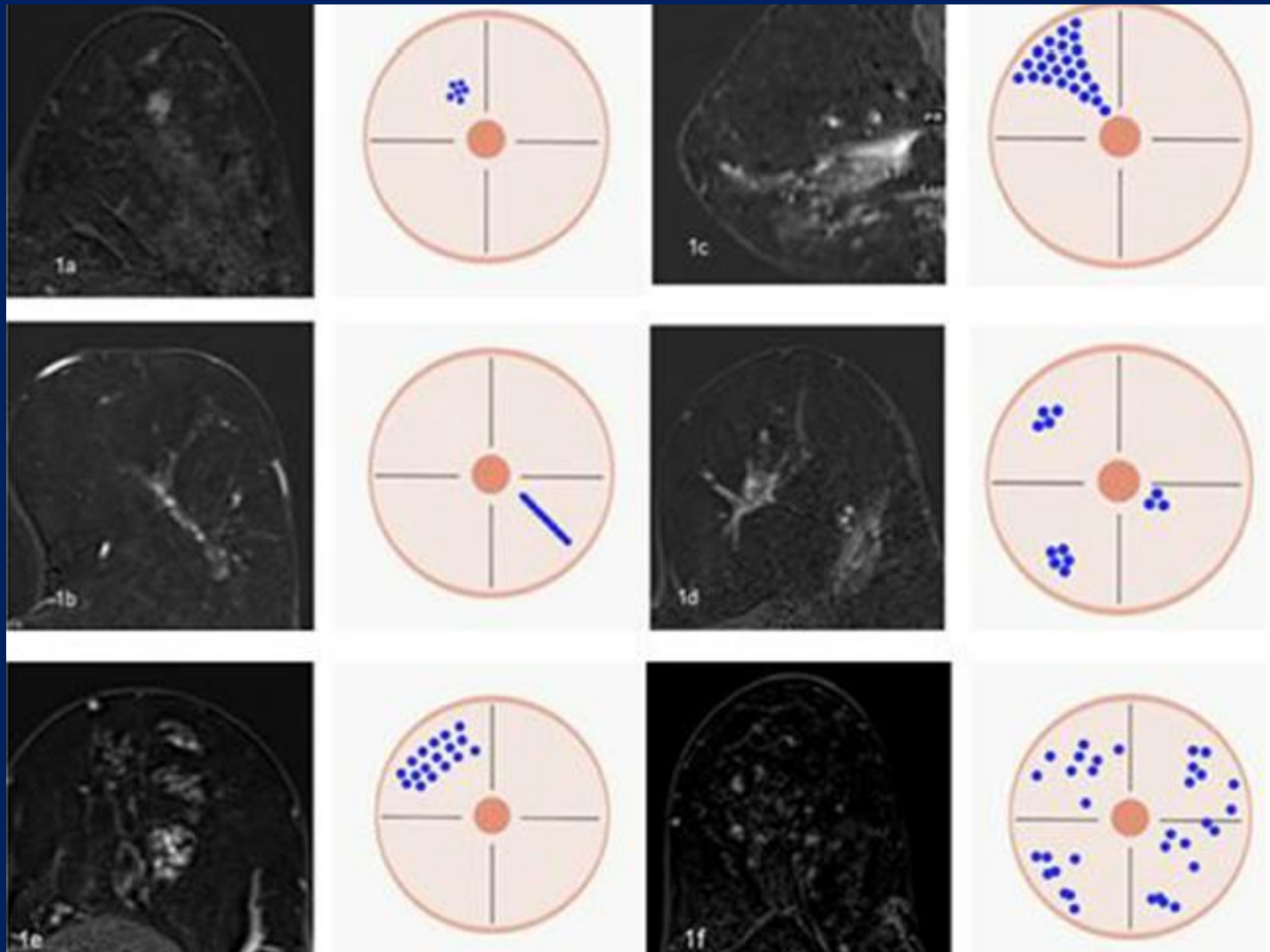
Correlation of Clinical and Imaging Findings

- NME is **challenging** finding in breast MR imaging interpretation.
- **overlap** in appearance of **benign** and **malignant NME** distributions and internal enhancement patterns.
- Its **accurate description** and **classification** are influenced by **Radiologist experience, hormonal influences** on healthy breast tissue

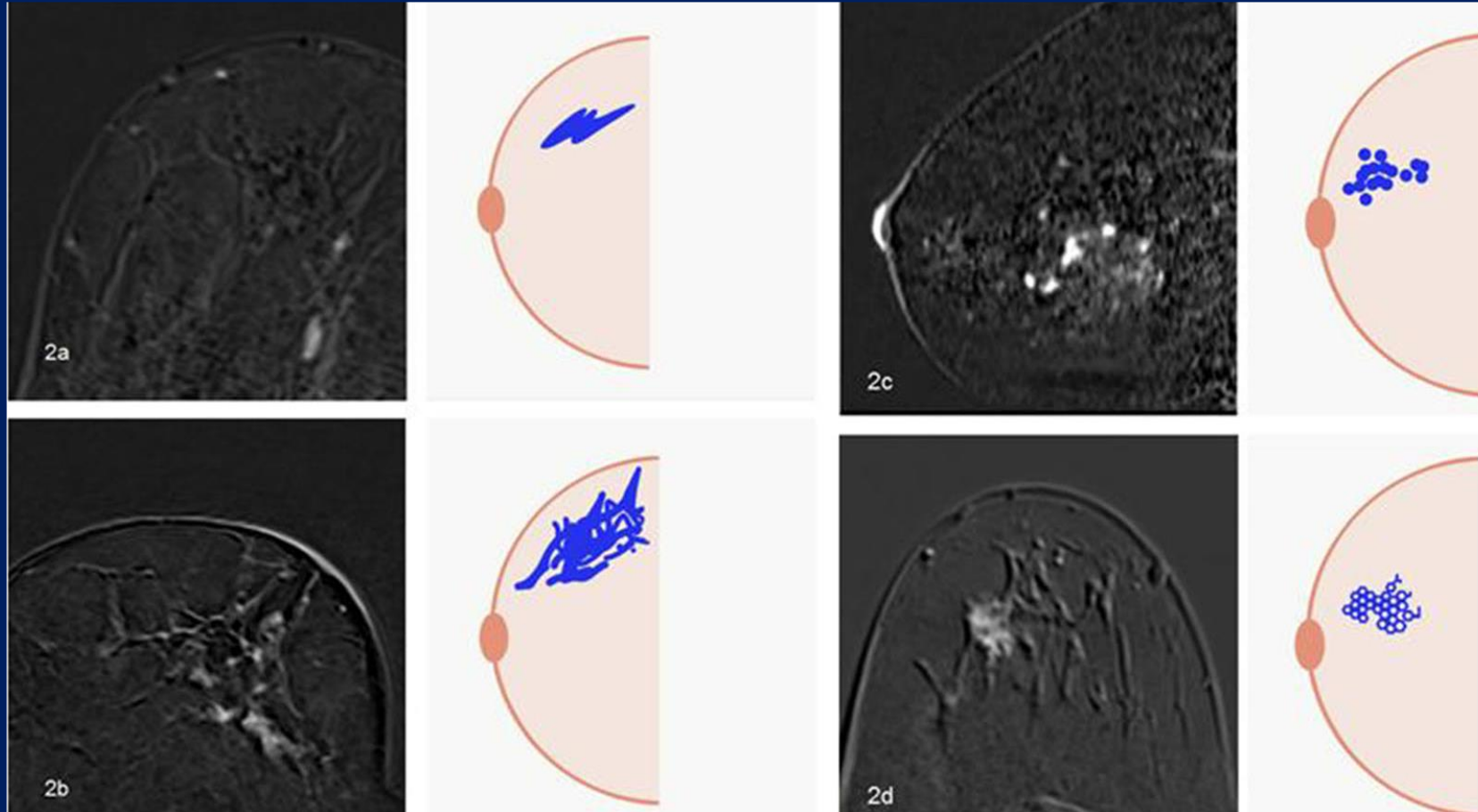
Management

- **Segmental** distribution, **clustered-ring** enhancement, **Rapid- plateau washout** dynamic type, and **lower ADC** value are **significantly** more frequent in **malignant** lesions.
- An **MR** imaging **finding** that generates a **low level of suspicion**, such as NME described as **regional or a focal** area with **slow or persistent** enhancement, may become **more suspicious** if there is an accompanying **clinical complaint**, a **high-risk status**, or a **correlative mammographic or US finding**
- It is **essential** for the **radiologist** who is **interpreting breast MR** images to review (a) **the findings from recent mammography and US** and (b) the **patient's questionnaire for any clinical complaints**

distribution



Internal Enhancement



NME

**Segmental, linear >1cm branching
clustered-ring or clumped**

suspicious

Biopsy


Linear <1cm, multiple regional and diffuse distribution with
homogeneous internal enhancement pattern **and negative
second look evaluation**

BI-RADS 3

low level of suspicion NME described
**clinical complaint, a high-risk status, or a correlative mammographic or
US finding**

suspicious

Biopsy



Thank
you!

