

In the name of GOD

Non-Mass Enhancement
at breast MRI

Dr Fahimeh Azizi

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TEHRAN UNIVERSITY
OF
MEDICAL SCIENCES

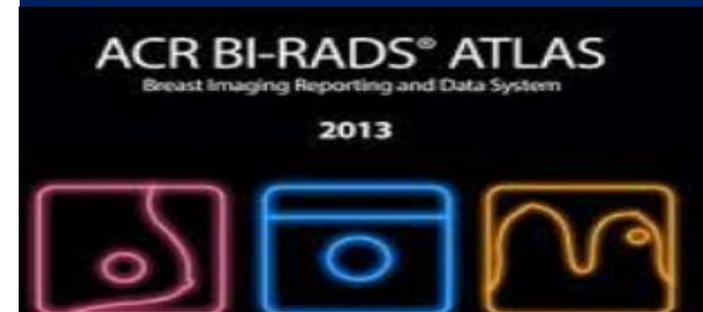
Management of Non-Mass Enhancement at Breast Magnetic Resonance in Screening Settings Referred for Magnetic Resonance-Guided Biopsy

Eduardo de Faria Castro Fleury¹ , Caio Castro², Mario Sergio Campos do Amaral² and Décio Roveda Junior²

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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

Tatsunori Asada¹ · Takayuki Yamada¹ · Yoshihide Kanemaki² · Keichi Fujiwara³ · Satoko Okamoto² · Yasuo Nakaiima³

BREAST IMAGING

1343

Patterns of Nonmasslike Enhancement at Screening Breast MRI: Review of Patterns With Radiologic-Pathologic Correlation and Discussion of Management

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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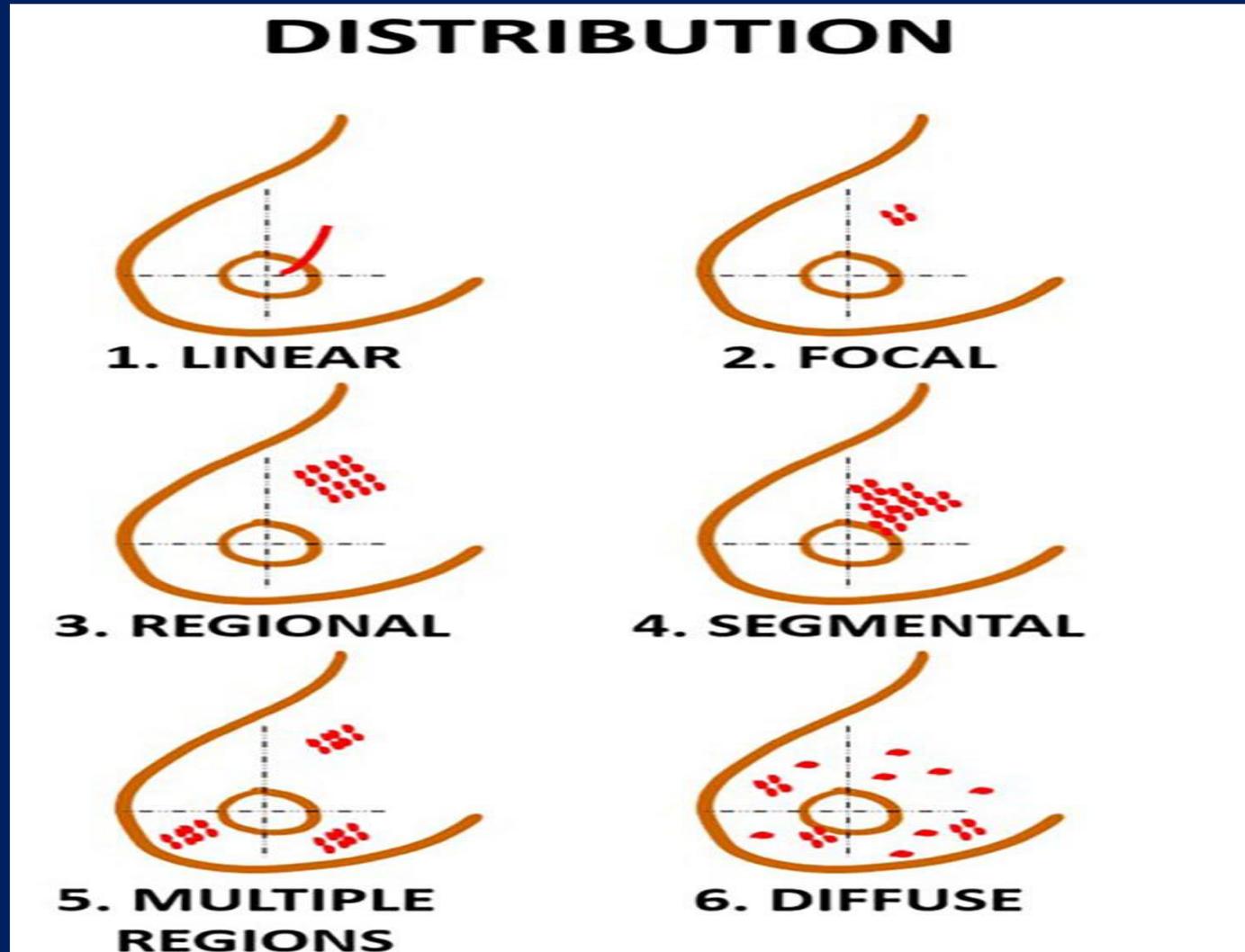
Titles:

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

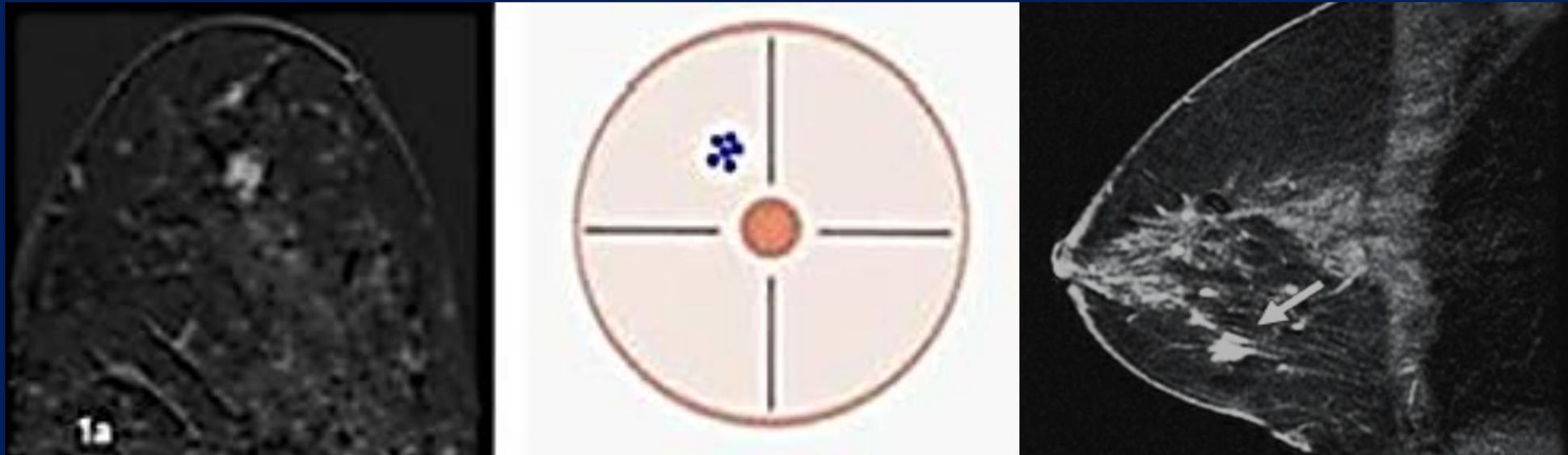
NME definition

- 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

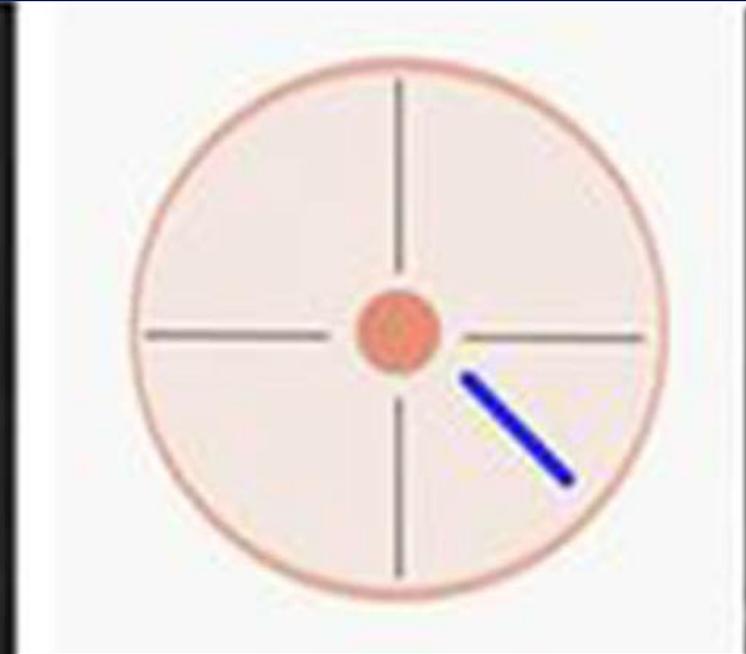
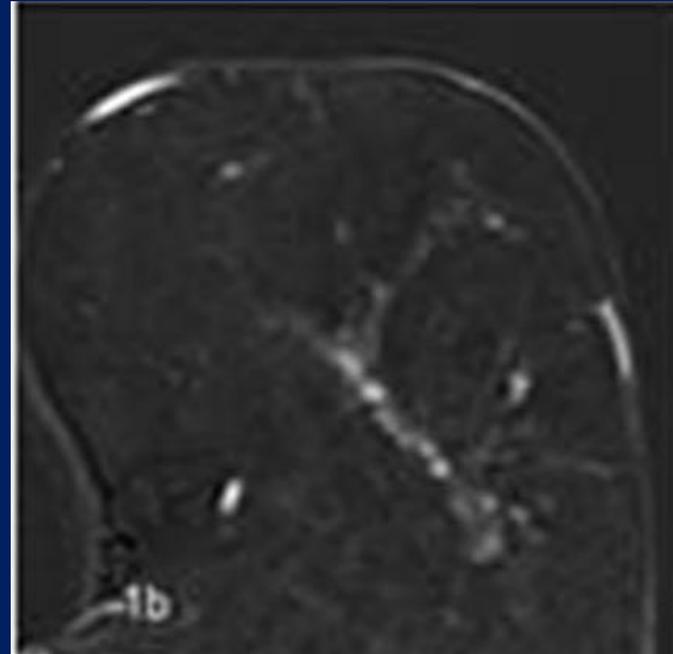
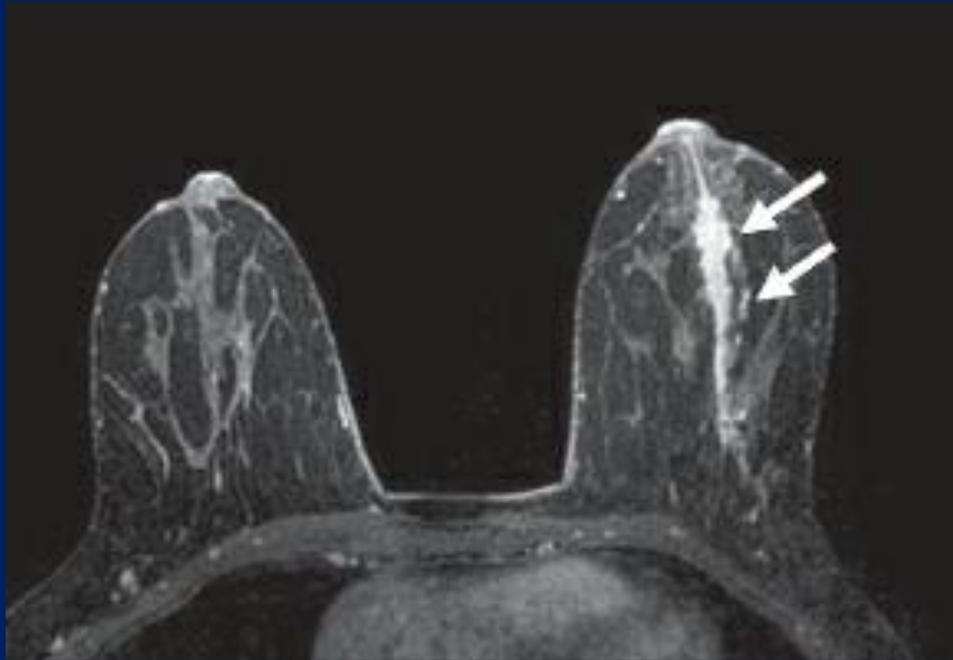


Focal NME: less than 25% of quadrant



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

Linear NME:

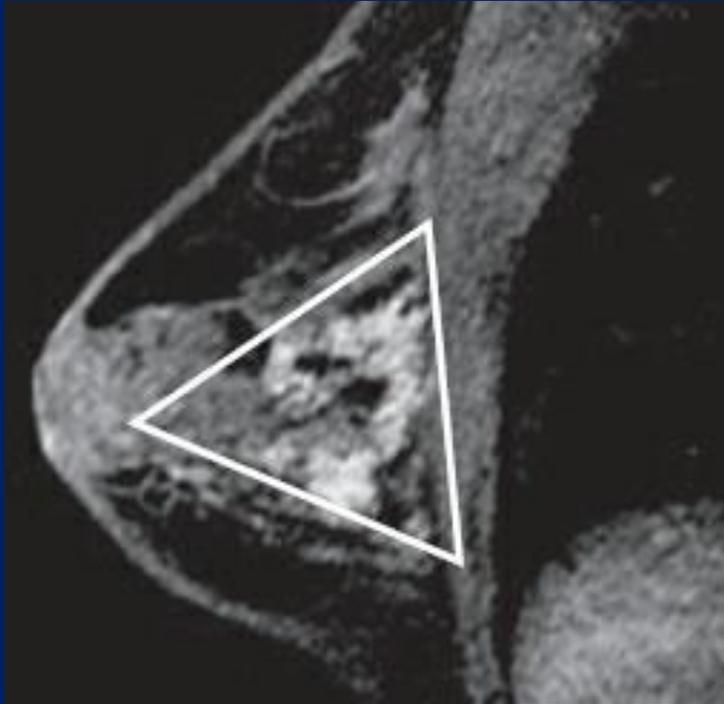


Enhancement in a line: straight, curved, or branching arrangement of enhancement, suggestive of ductal or periductal involvement

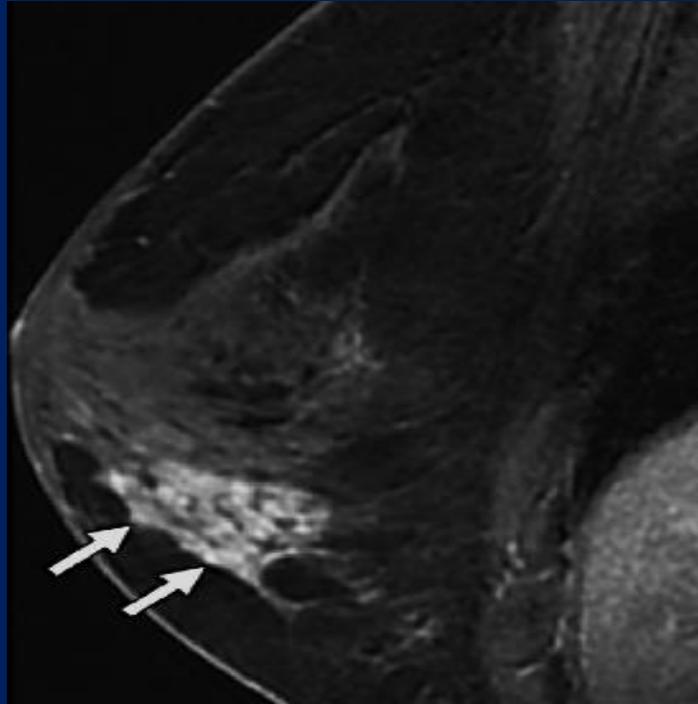
DCIS

Segmental NME:

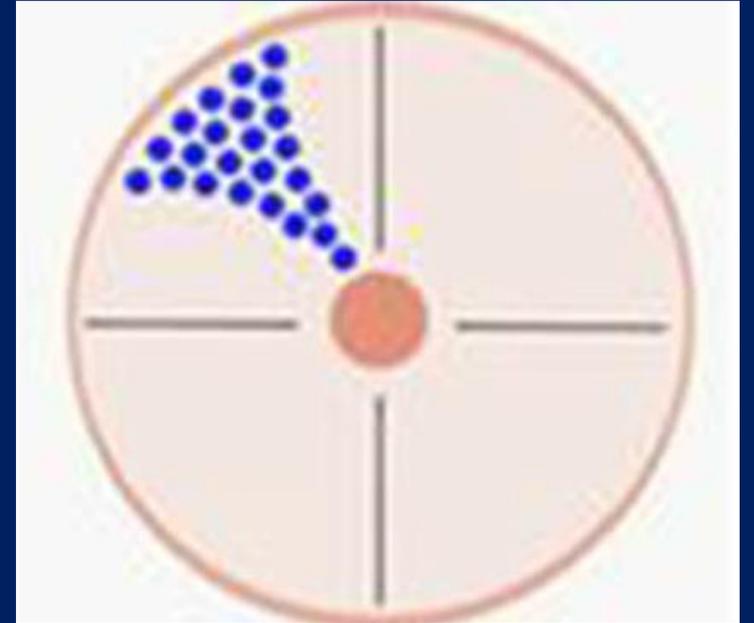
Triangular or conical, apex pointing to nipple,



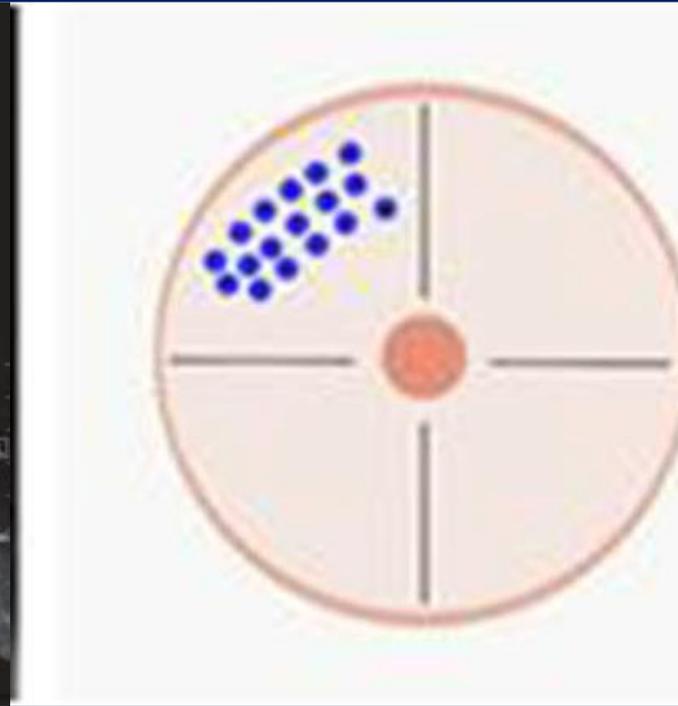
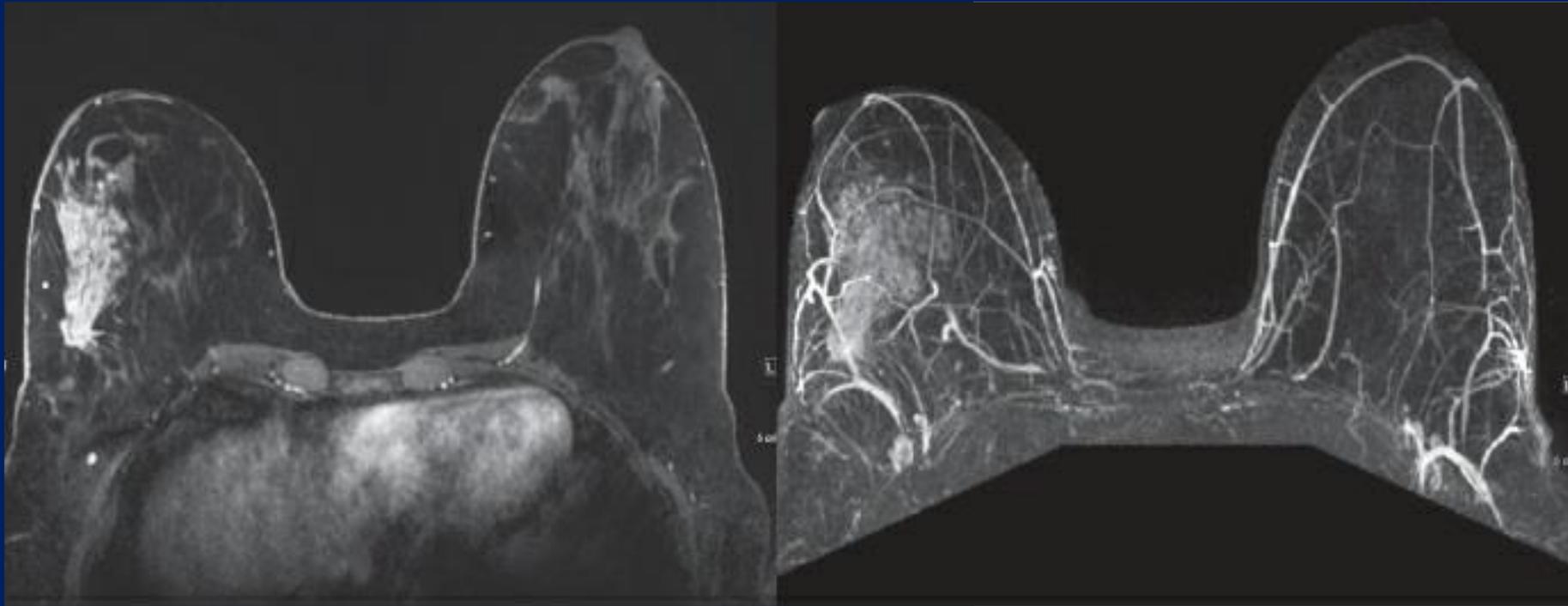
invasive lobular carcinoma.



DCIS

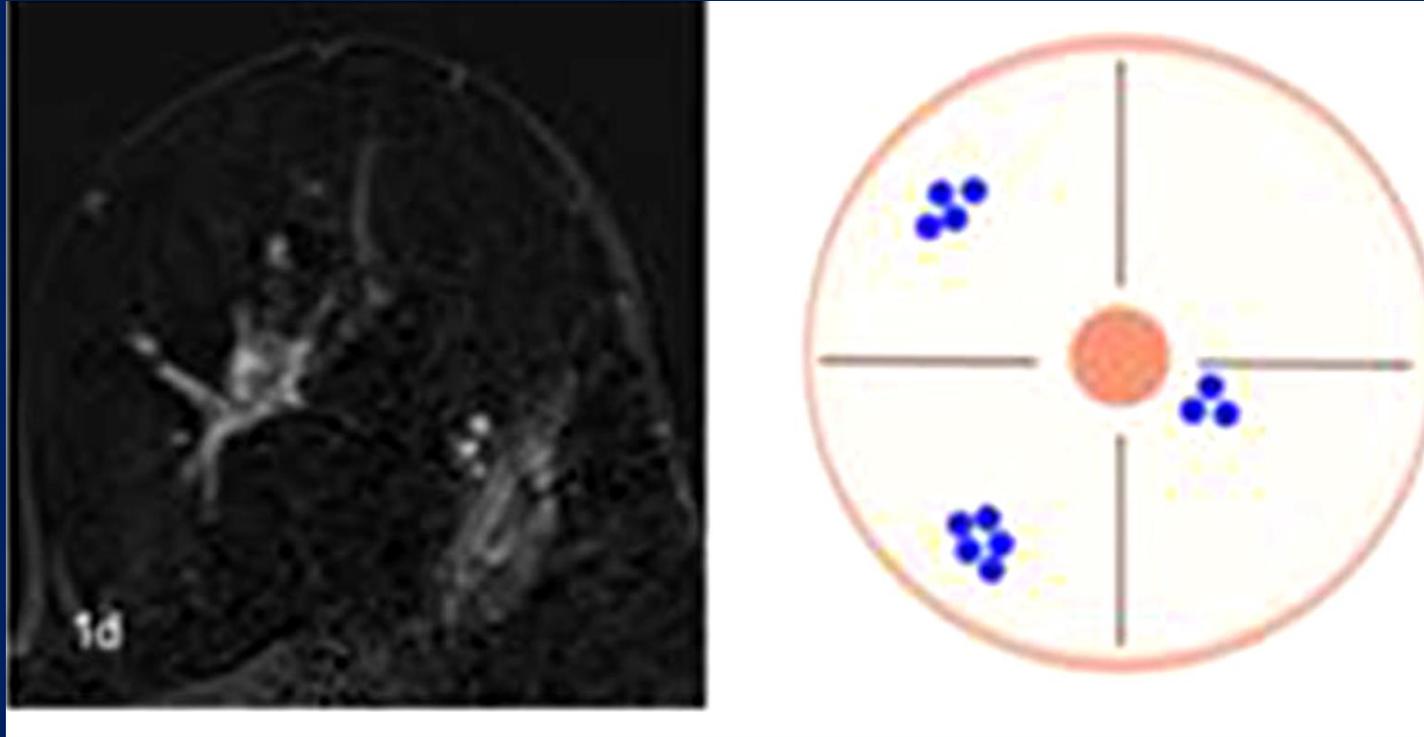


Regional NME:

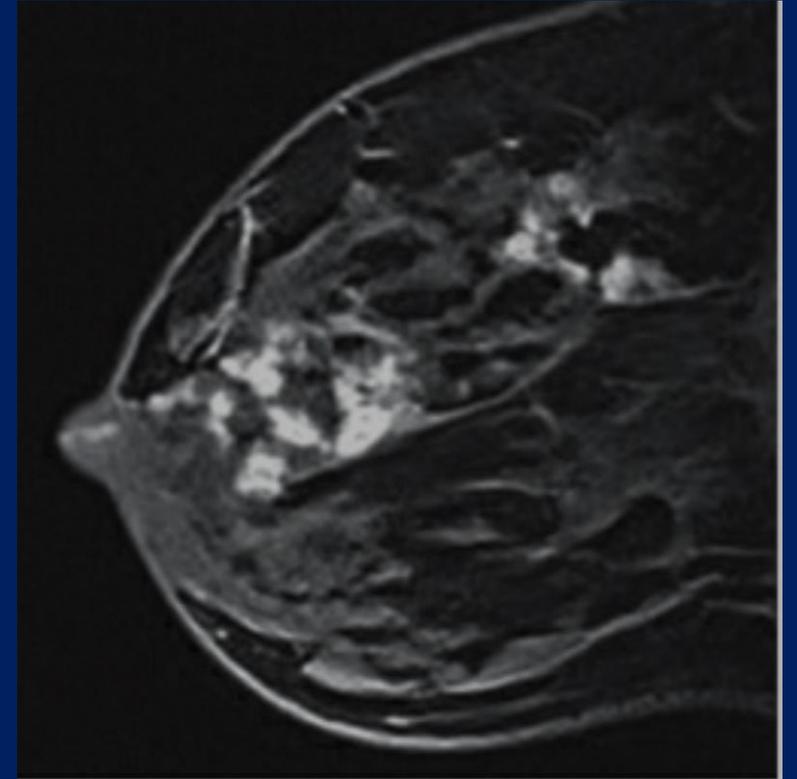


area larger than a breast quadrant
geographic
not conforming to duct distribution

Multiple regions NME:

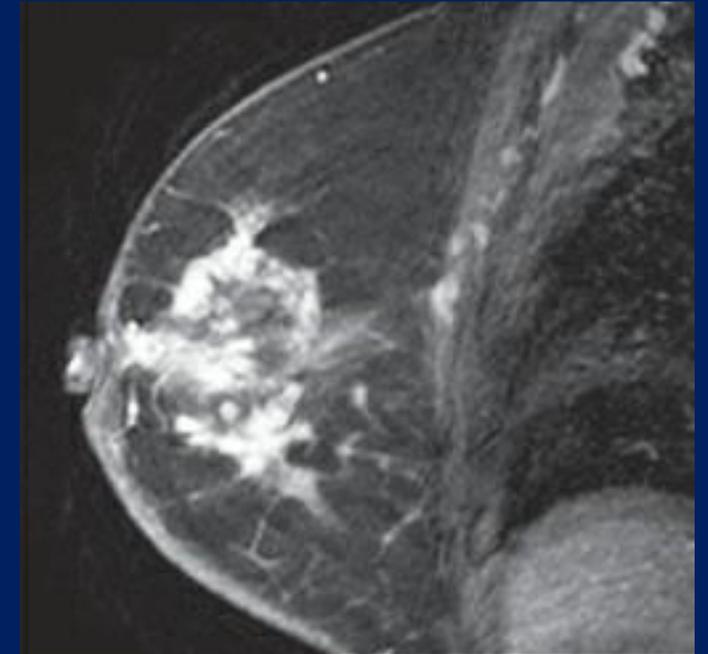
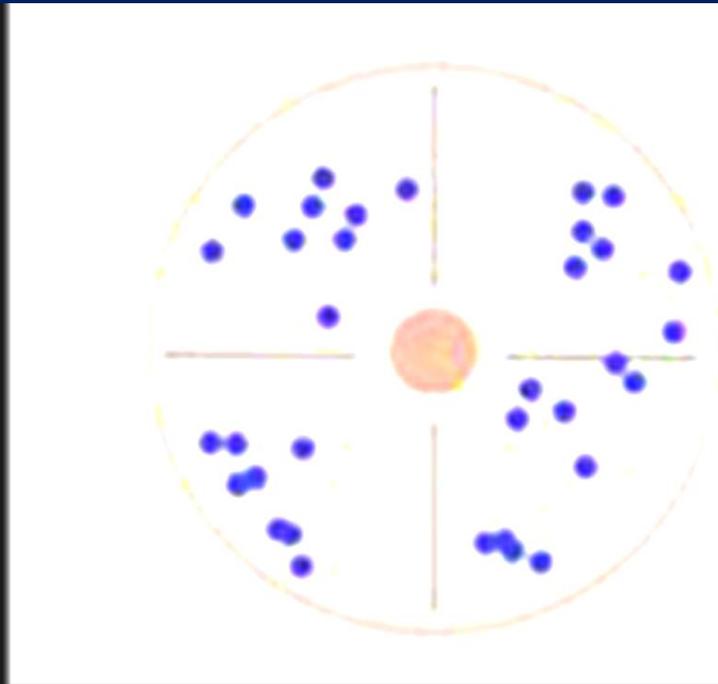
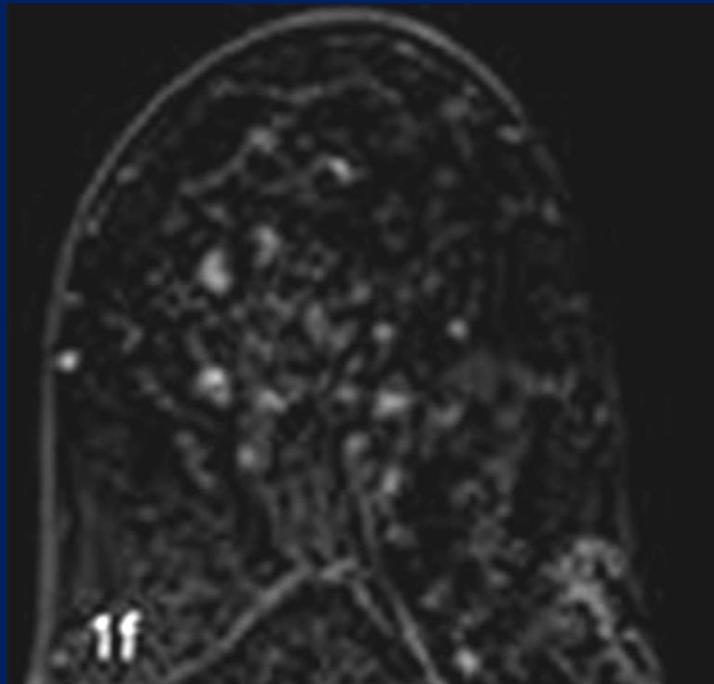


enhancement over at least two large volumes of tissue
separated by normal tissue
not conforming to a ductal distribution (patchy)



A 74-year-old woman
invasive lobular carcinoma.

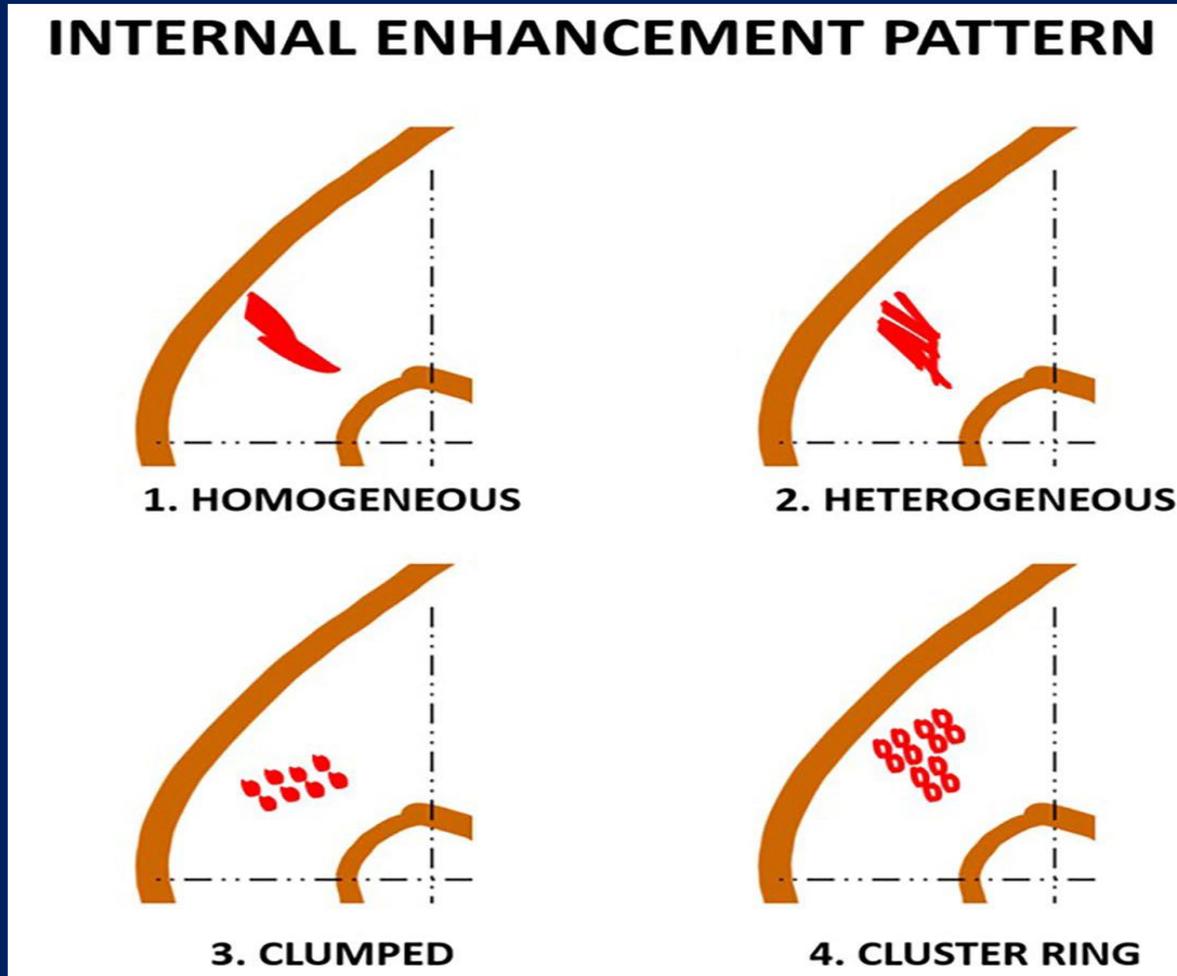
Diffuse NME:



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

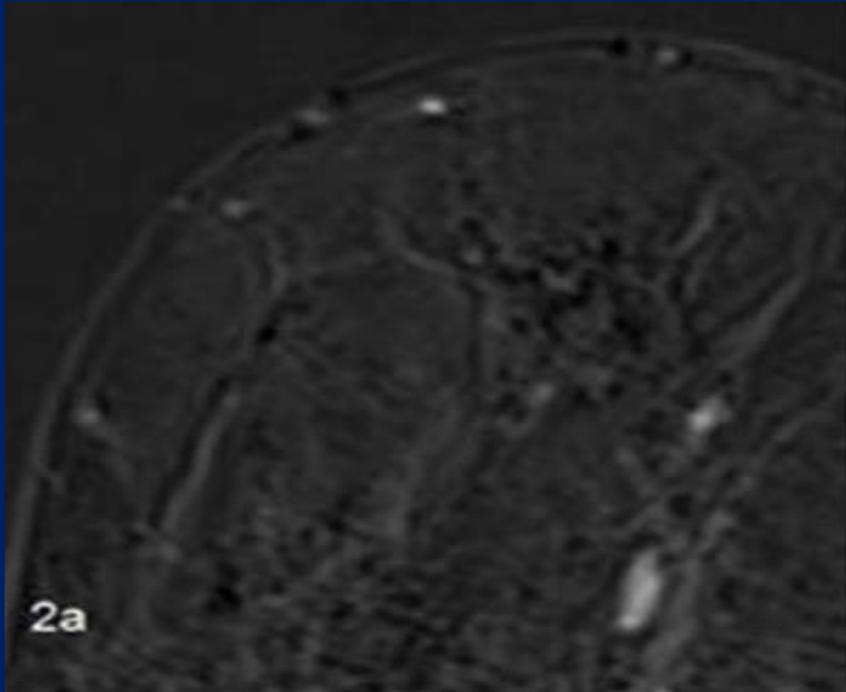
49y/o
IDC

NME Internal enhancement patterns

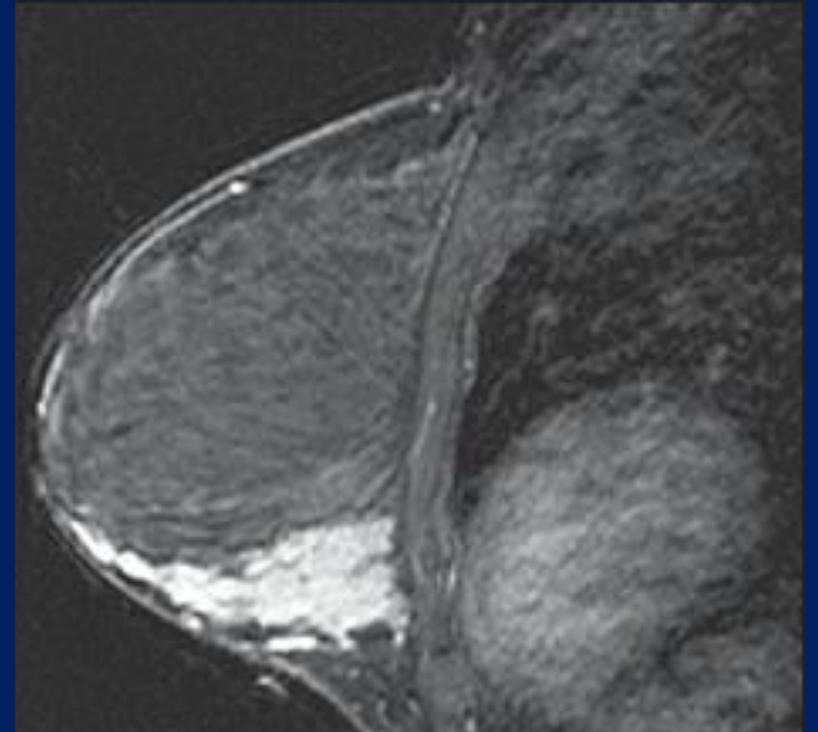


~~Stippled, punctate,
"sand-like" or dot-like
Reticular, dendritic –
finger-like projections~~

Homogenous enhancement NME: confluent and uniform



usual ductal hyperplasia.

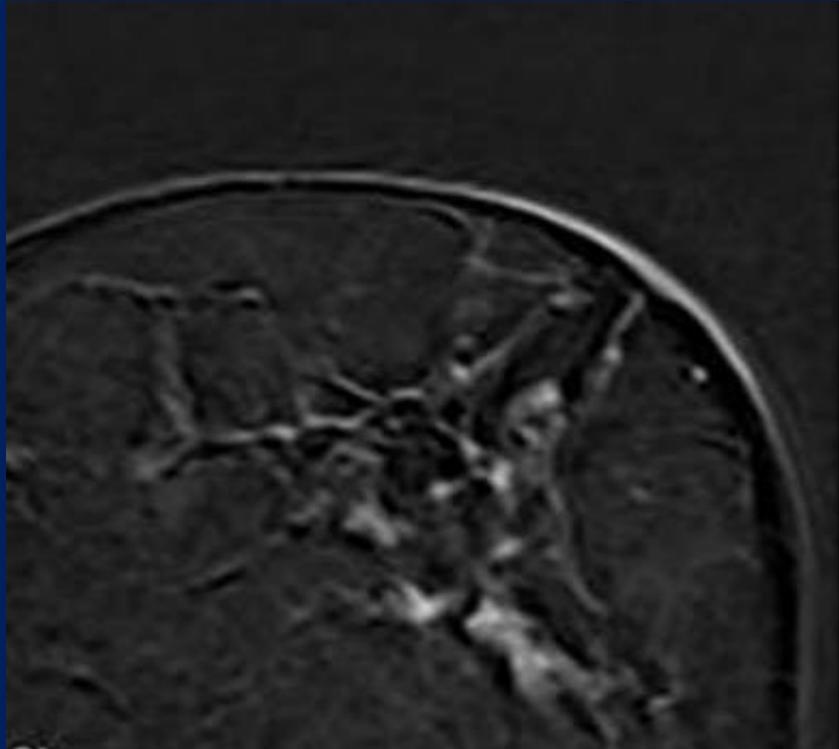


Sclerosing Adenosis

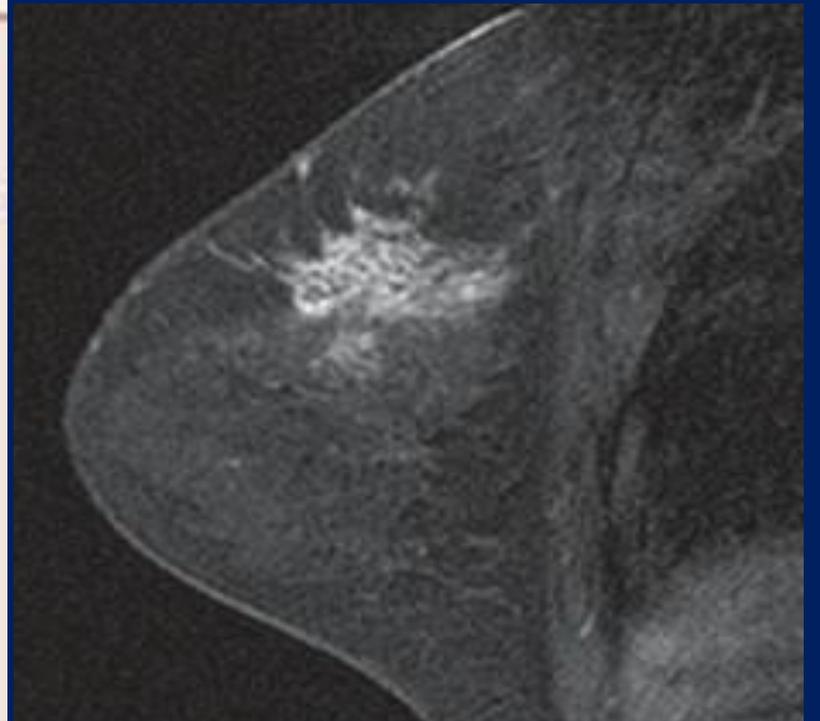
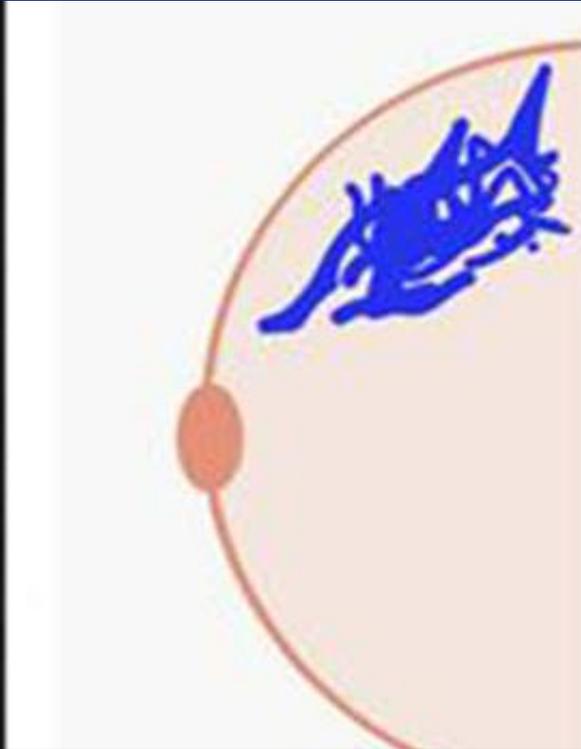
Heterogeneous enhancement NME:

non-uniform pattern

randomly separated by normal tissue



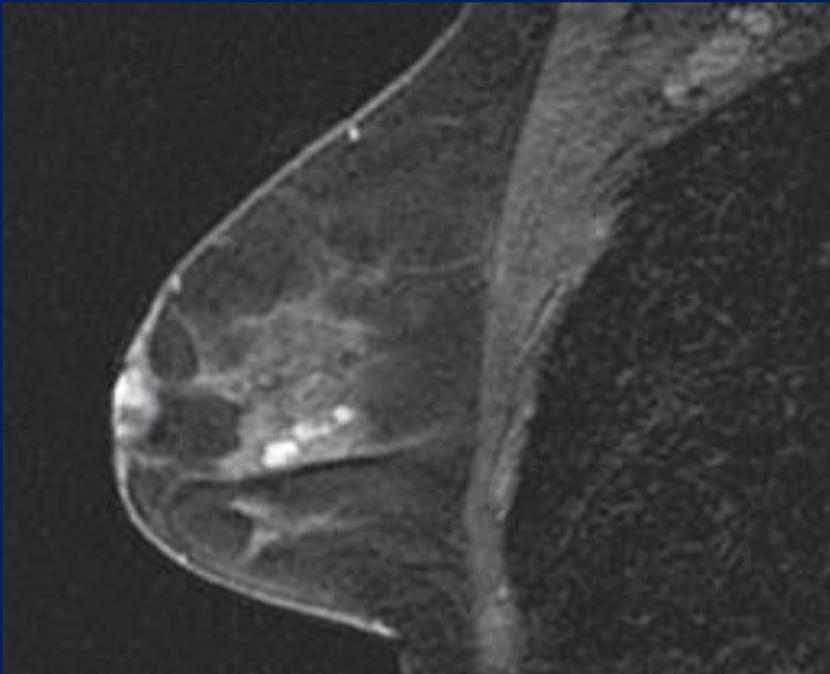
apocrine focal metaplasia



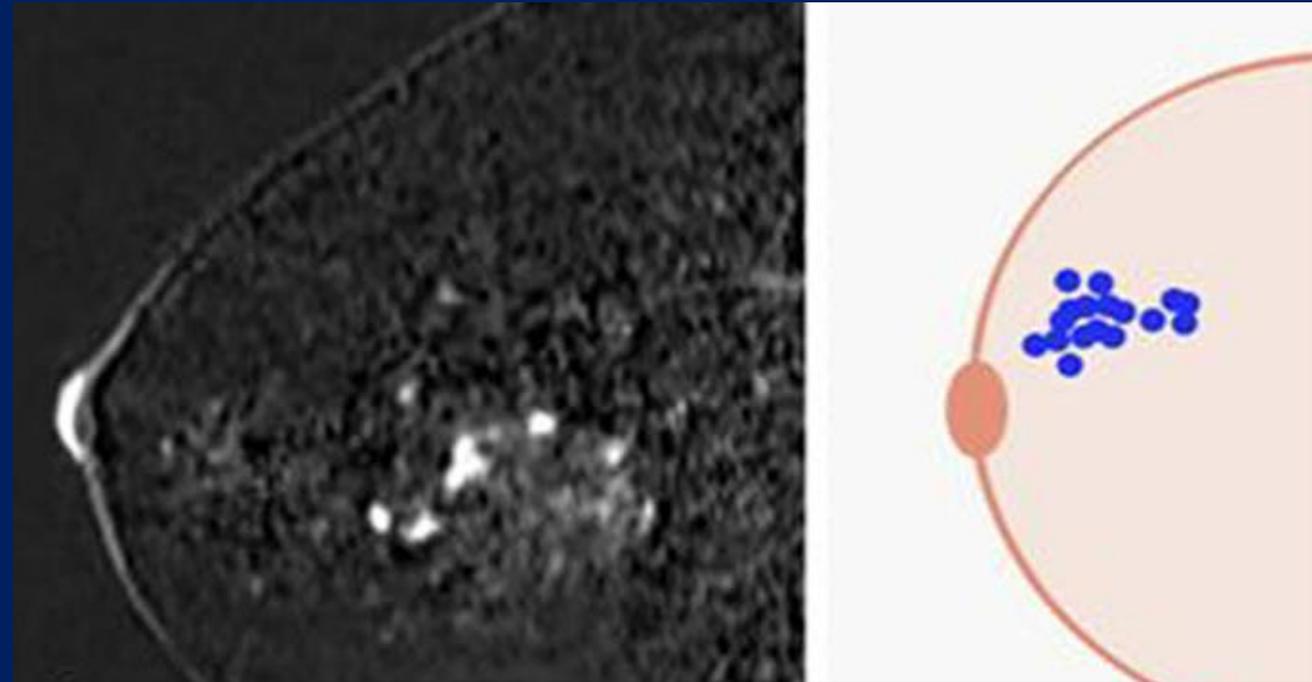
DCIS

Clumped enhancement NME:

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



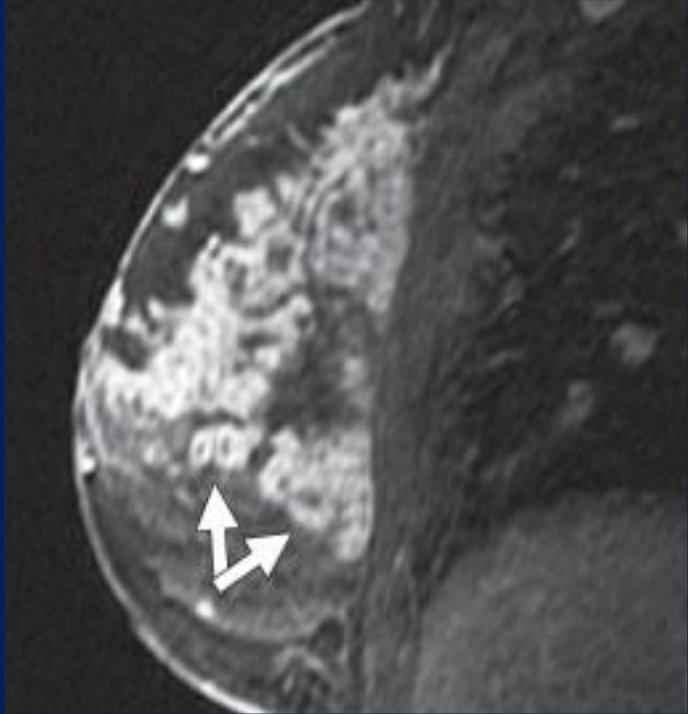
DCIS



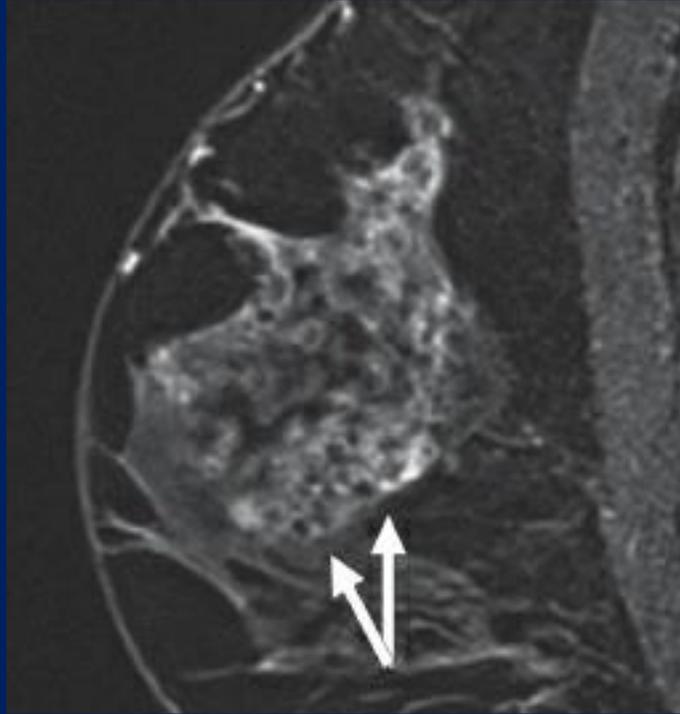
PASH:pseudoangiomatous stromal hyperplasia and fibrosis.

Cluster ring enhancement NME:

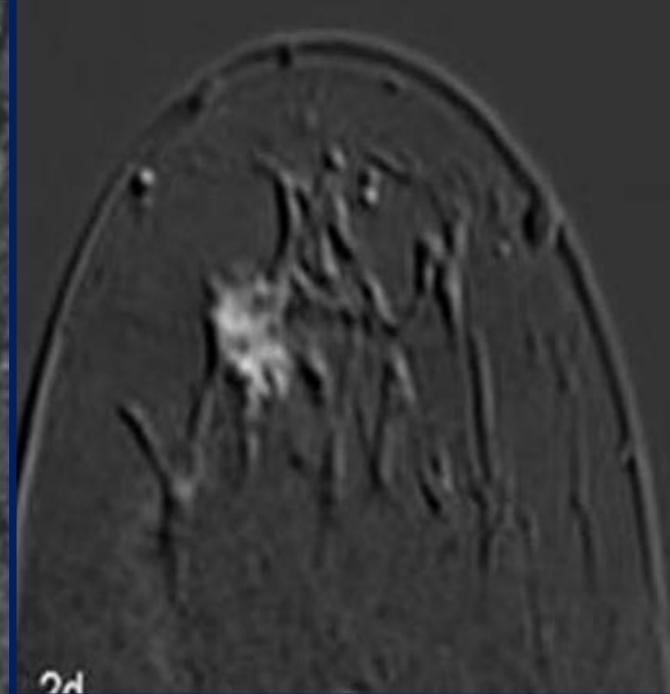
multiple small ring shapes closely arranged, suggestive of periductal involvement



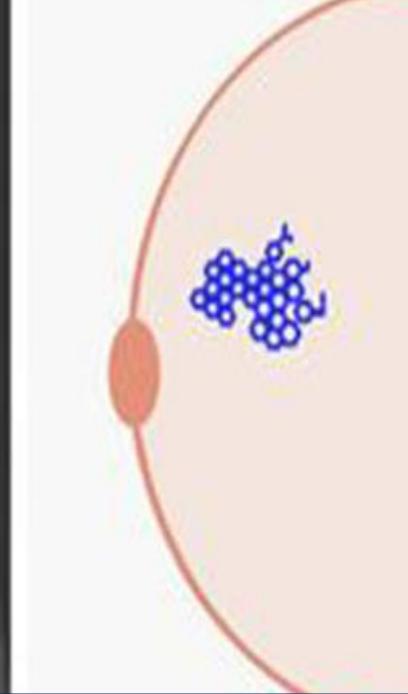
DCIS



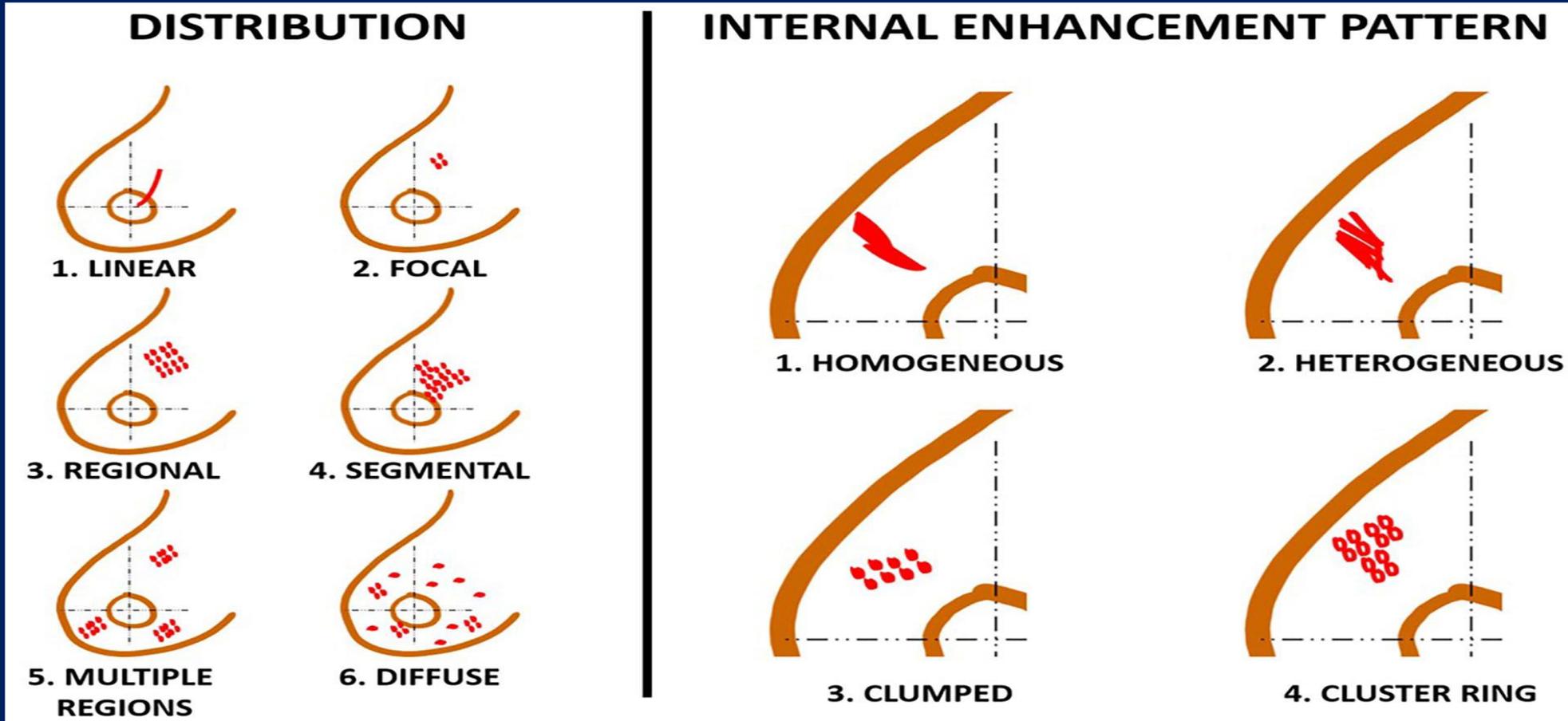
DCIS



Invasive lobular carcinoma



NME characteristics in breast MRI



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, Mario Sergio Campos do Amaral² and Décio Roveda Junior²

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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		<input type="checkbox"/> BI-RADS 3
<ul style="list-style-type: none">➤ Focal➤ Regional	✓ Heterogeneous ✓ Clumped		<input type="checkbox"/> BI-Rads 4a
<ul style="list-style-type: none">➤ Segmental	✓ Clustered-ring		<input type="checkbox"/> 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

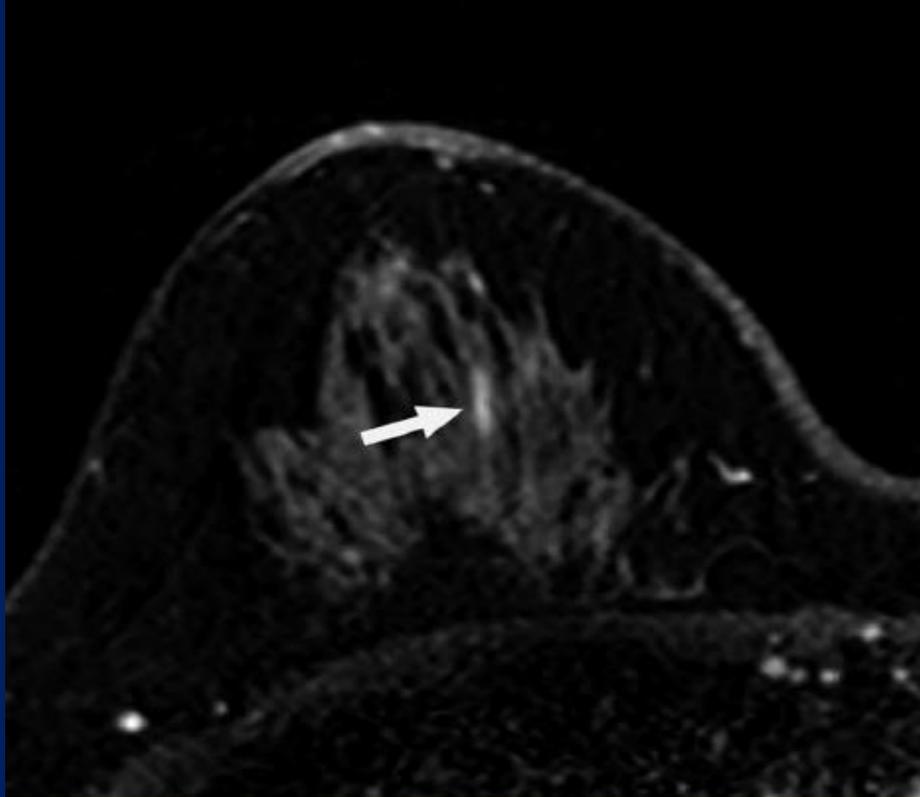
a: Linear (single line) subtype **smaller than 1 cm**. This is **minor** suspicious **regardless of internal enhancement** linear pattern of **1 cm or more**, and a **branching** pattern: were classed as **intermediate (1)**

b: Regional, multiple and diffuse were inconclusive for grades

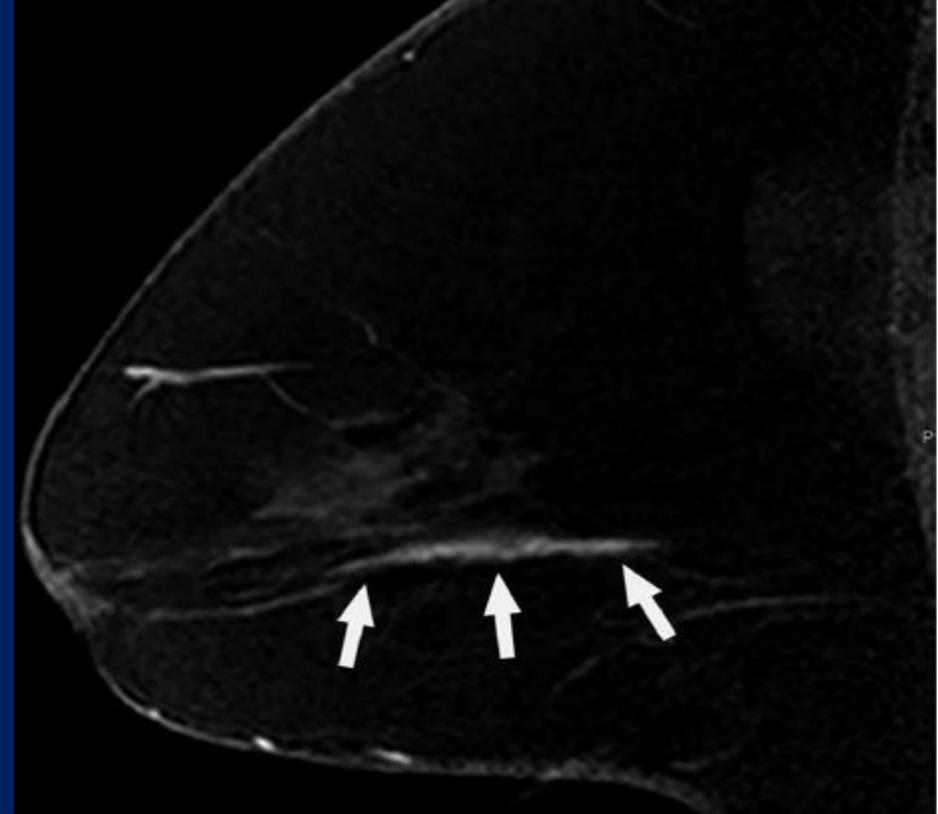
Sum score	Category	Internal enhancement/distribution	Malignant* (n = 178)	Benign* (n = 35)	Total	PPV (%)
4	5	Clustered ring/segmental	106	7	113	93.8
3	4C	Clumped/segmental	15	5	20	81.1
		Heterogeneous/segmental	17	2	19	
		Clustered ring/focal	23	6	9	
		Clustered ring/linear	1	0	1	
2	4B	Clustered ring/others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

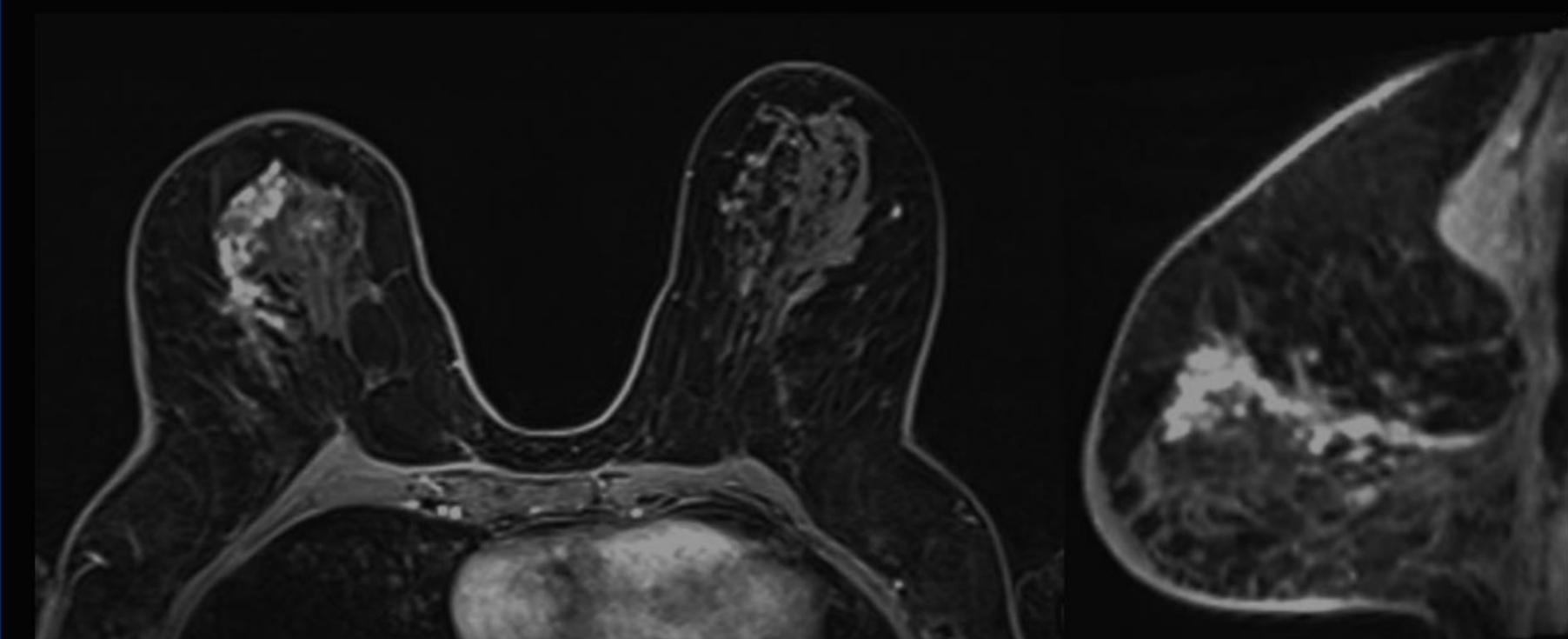
The probabilities of categories showed a significant difference (Fischer's exact test; $p < 0.0001$)



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



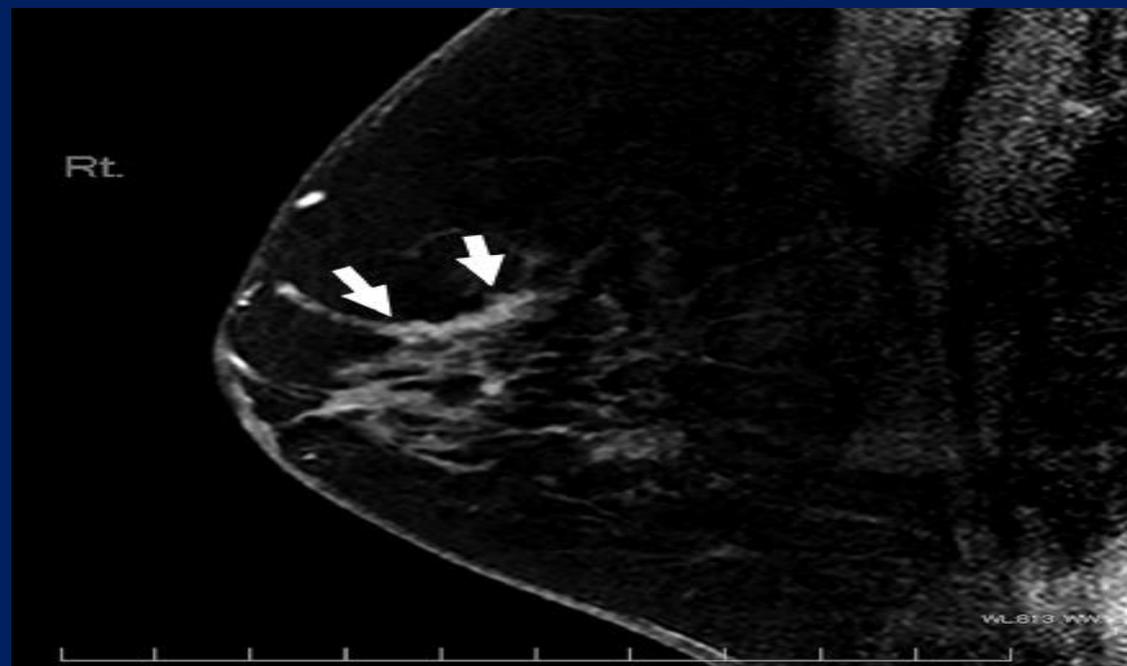
An 80-year-old woman with Sagittal
T1 fat-saturated dynamic MR image shows linear
distribution(3.3 cm) (1 point) with homogeneous
enhancement: **B4**
DCIS



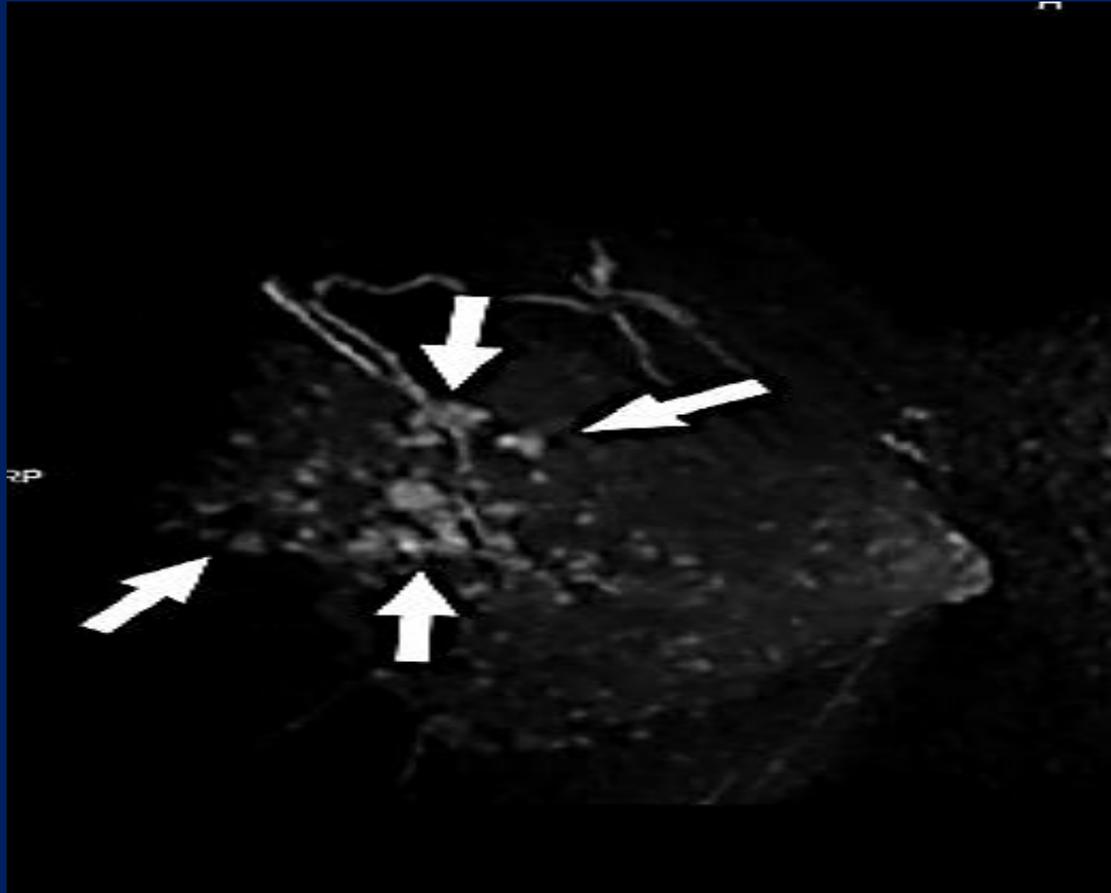
Linear branching NME with clumped enhancement: 2point, B4
Lobular Carcinoma



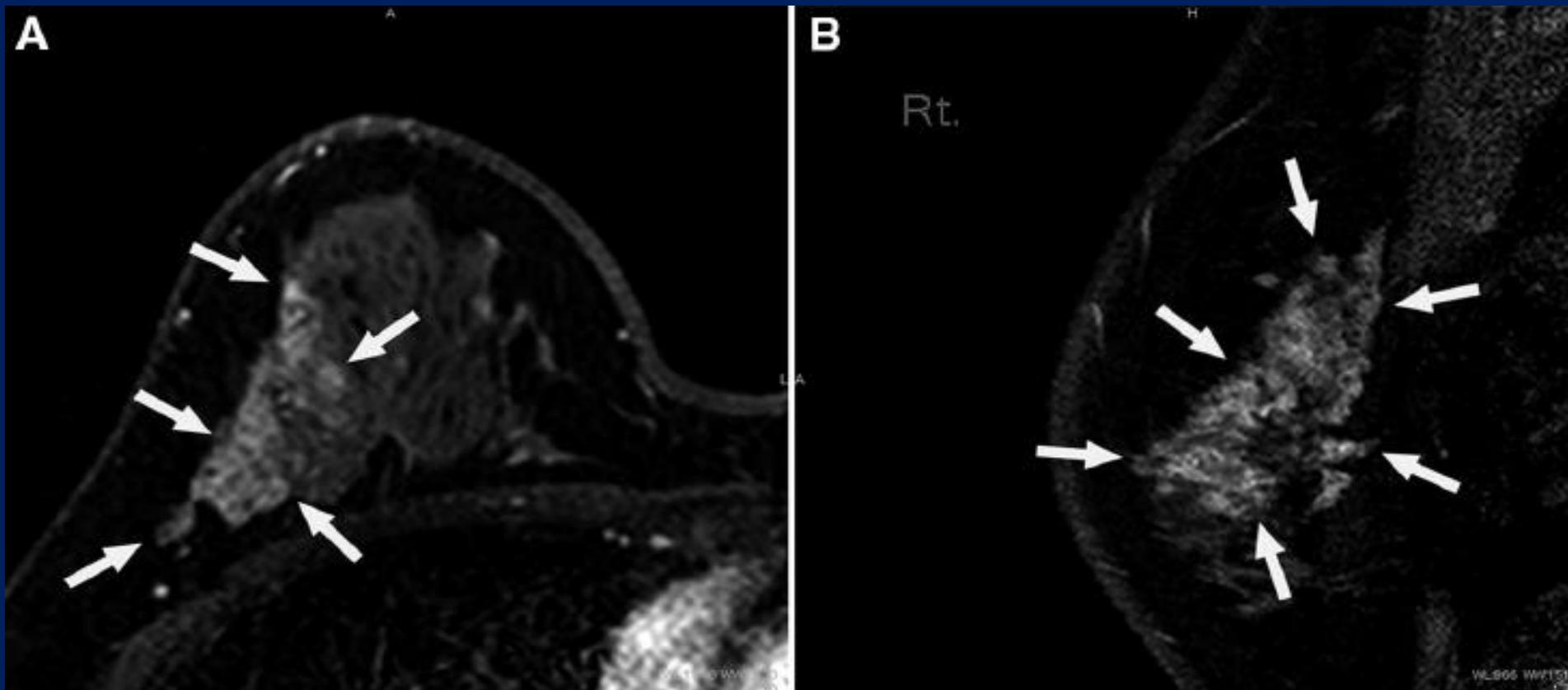
44y/o Transverse T1 fat-saturated:
focal NME (1 point) with **homogeneous**
enhancement (0 points)= (1 point).
No histological examination was performed;
however,
the **2-year follow-up** study has shown no signs
of abnormalities.
The lesion was regarded as being **benign**.



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.



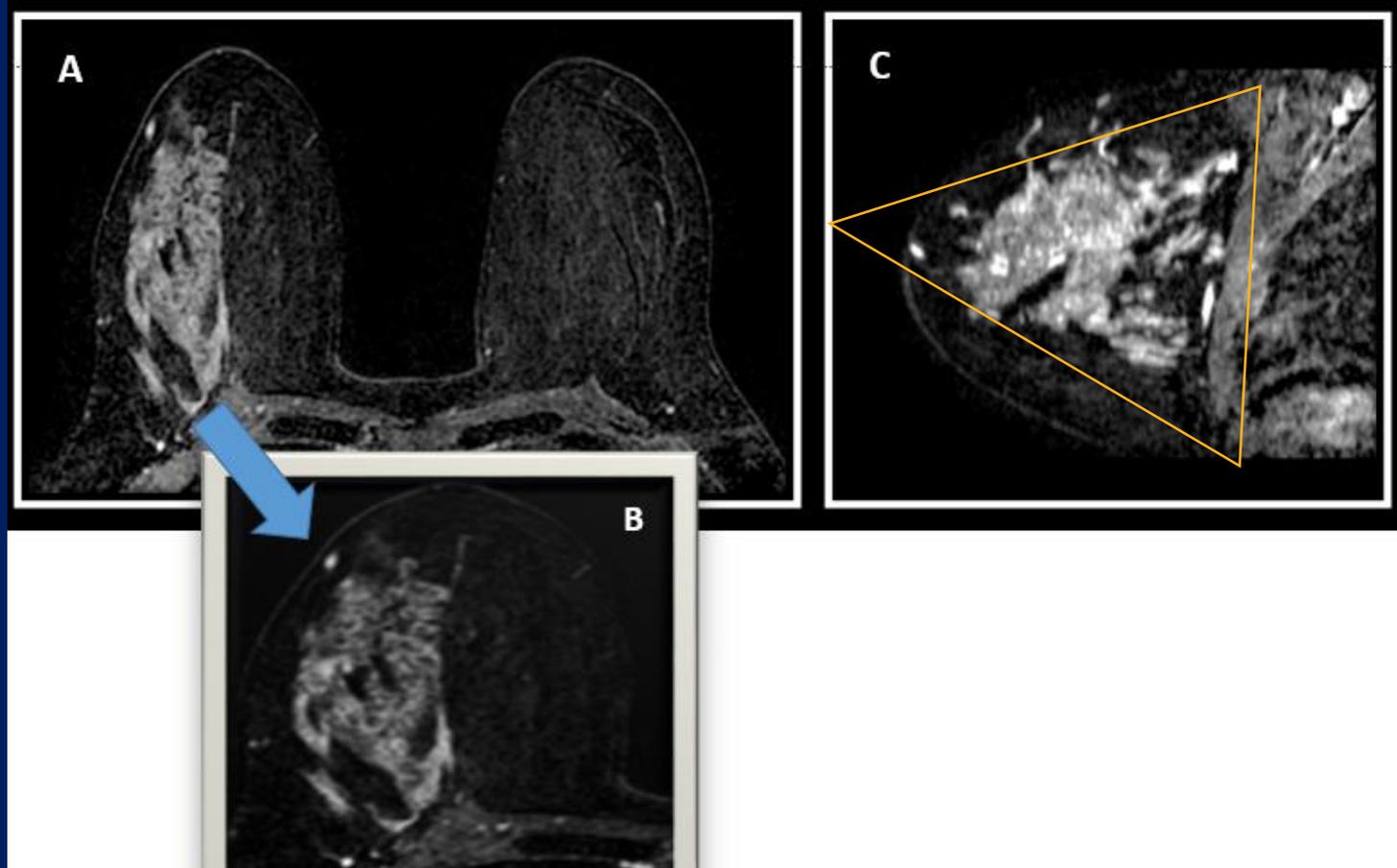
49y Transverse T1 fat-saturated :
**segmental NME (2 points) with clustered ring enhancement (2 points):
4point**

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)

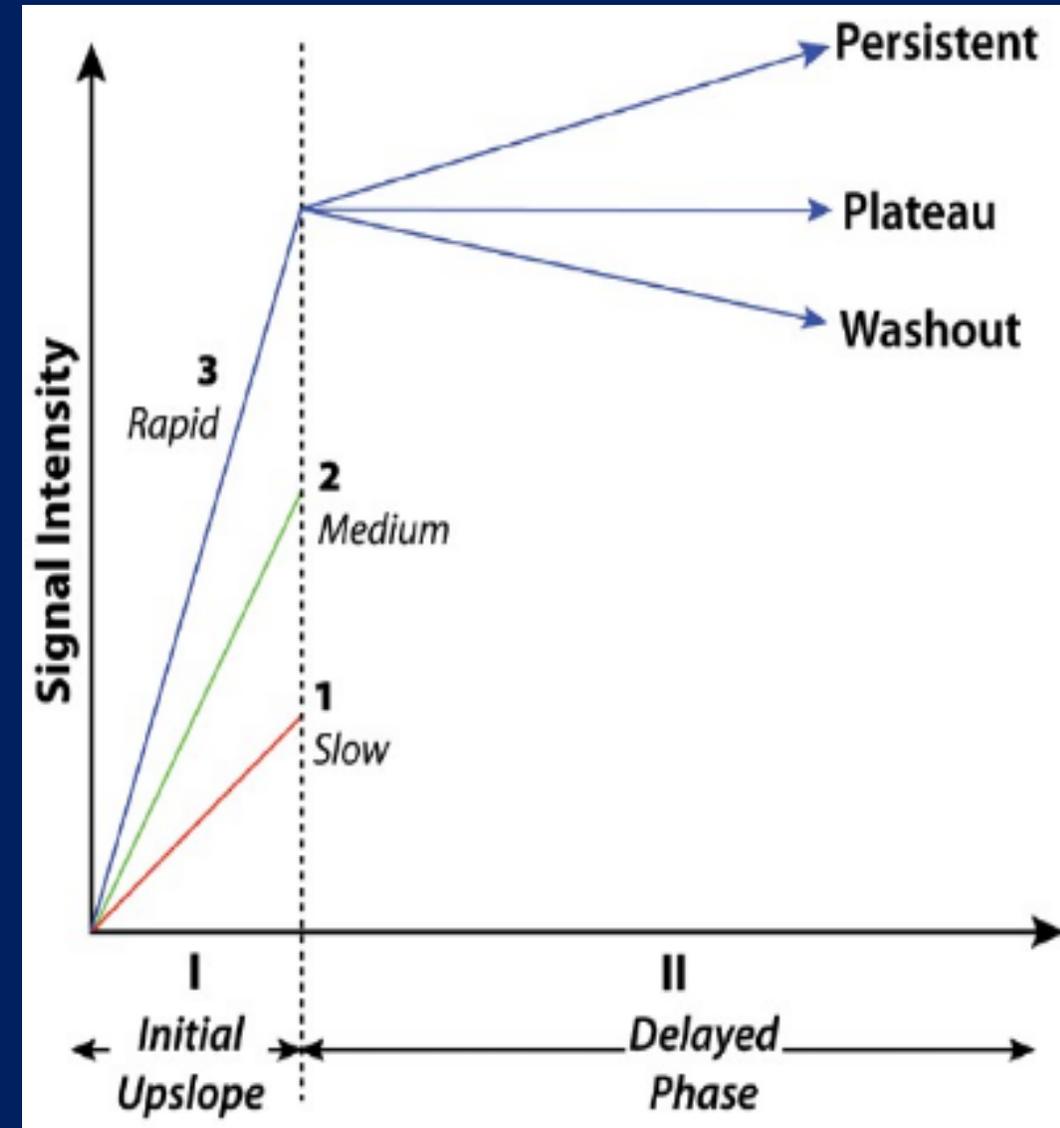
PMCID: PMC9011203

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, ≤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.**

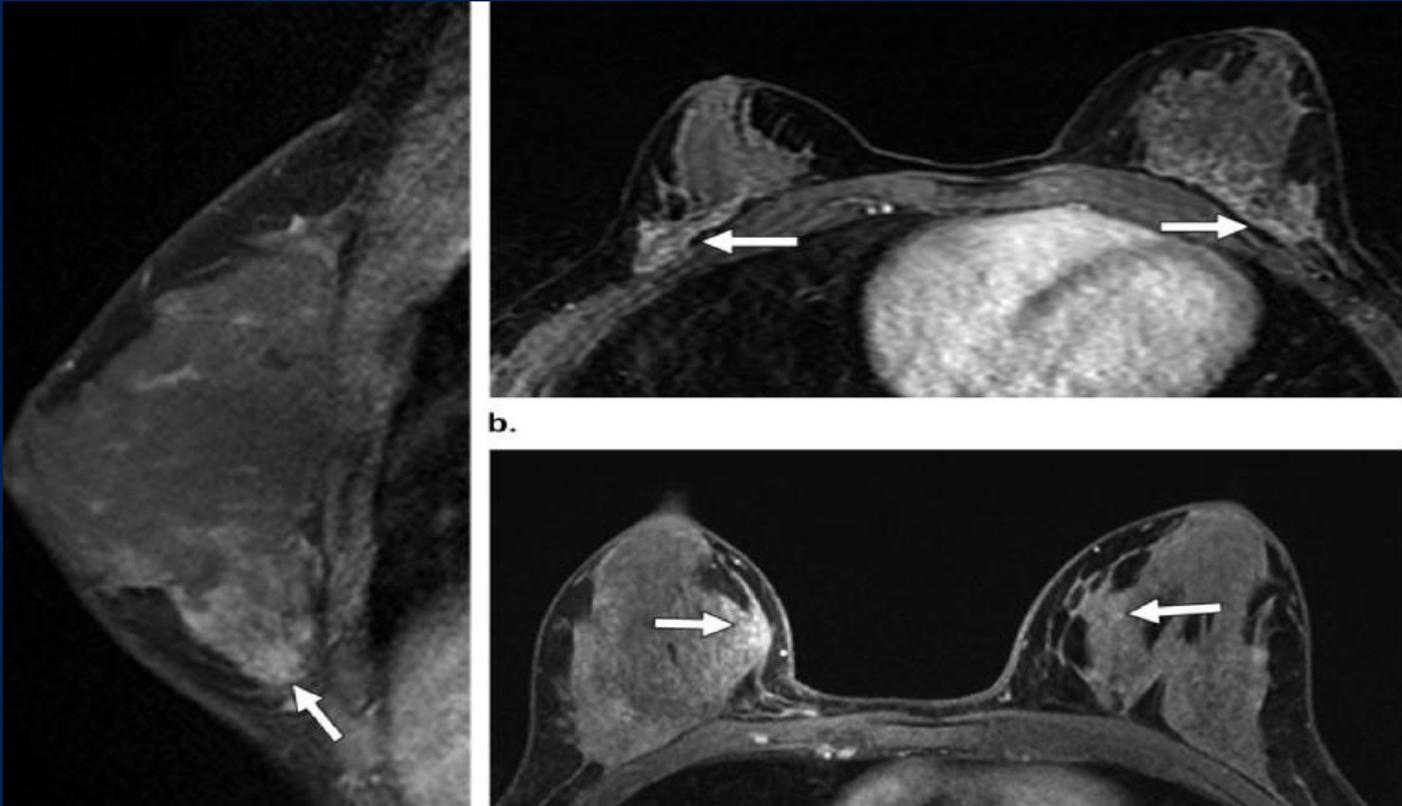
- For **slowly** and **persistently** enhancing **NME**, **delayed images** may be **more useful** for lesion **detection** and **analysis** than early dynamic images
- Conversely, in setting of **diffuse background enhancement**, **focal NME** may be **much less conspicuous** on **delayed** images than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

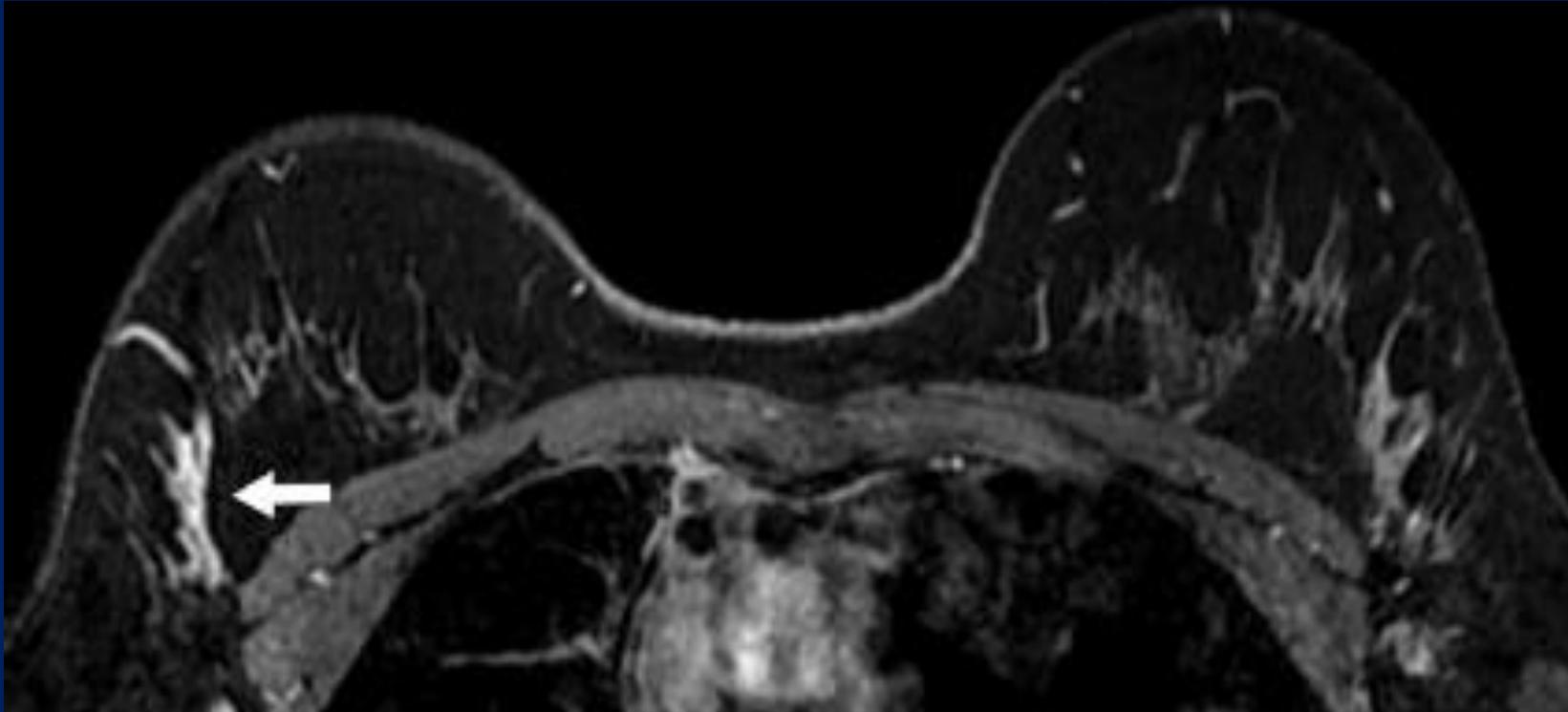
“Picture framing,” or normal enhancement from peripheral to central areas, in three different women who underwent screening MR imaging.



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

Correlate 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.

The image shows a screenshot of the American Journal of Roentgenology (AJR) website. The header is yellow and features the AJR logo on the left, a search bar in the center, and an 'ADVANCED SEARCH' button on the right. Below the header is a navigation menu with links for 'ARTICLES & ISSUES', 'COLLECTIONS', 'INFORMATION', 'AUTHORS', 'REVIEWERS', 'MULTIMEDIA', and 'SECTIONS'. The main content area is white and displays the article title: 'Revisiting Nonmass Enhancement in Breast MRI: Analysis of Outcomes and Follow-Up Using the Updated BI-RADS Atlas'. Above the title, it indicates 'Original Research | Women's Imaging | August 23, 2017'.

AJR American Journal of Roentgenology

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ADVANCED SEARCH

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

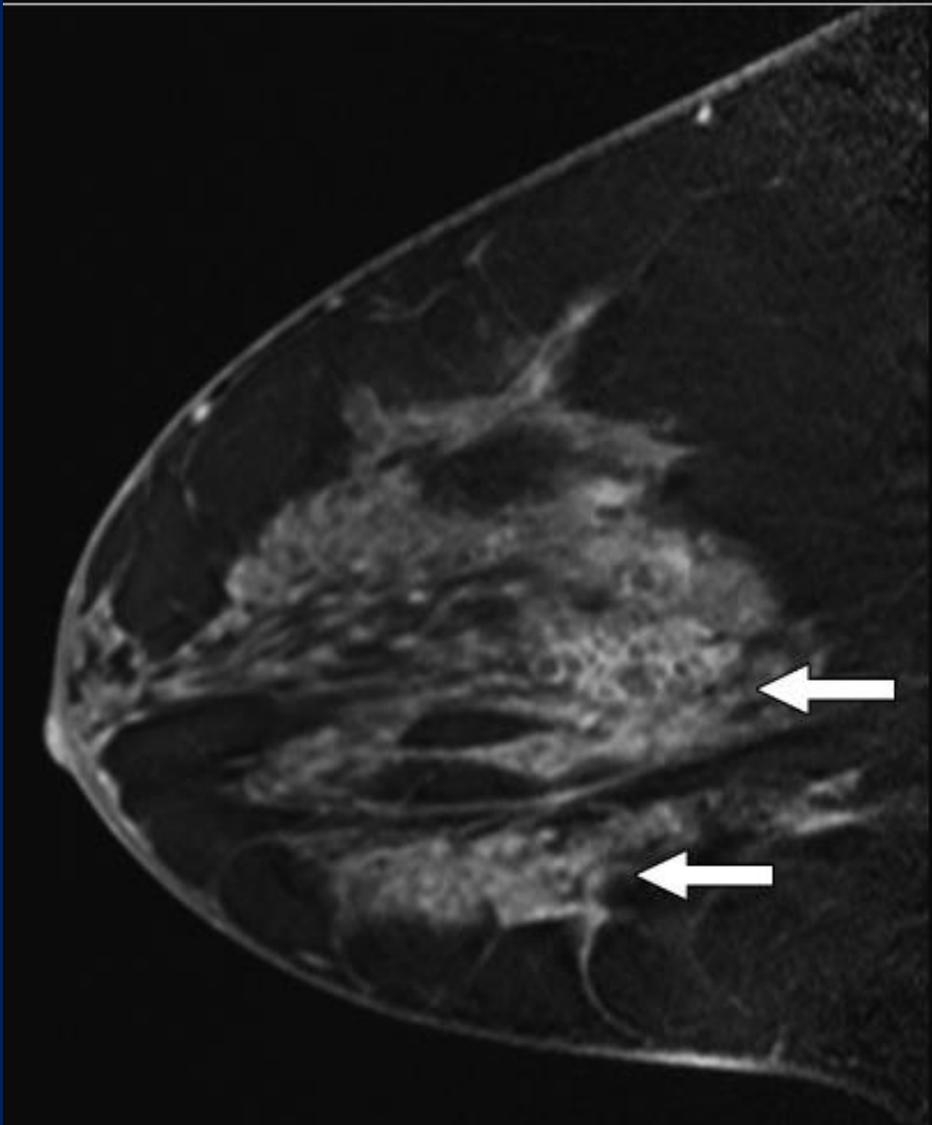
Revisiting Nonmass Enhancement in Breast MRI: Analysis of Outcomes and Follow-Up Using the Updated BI-RADS Atlas

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)

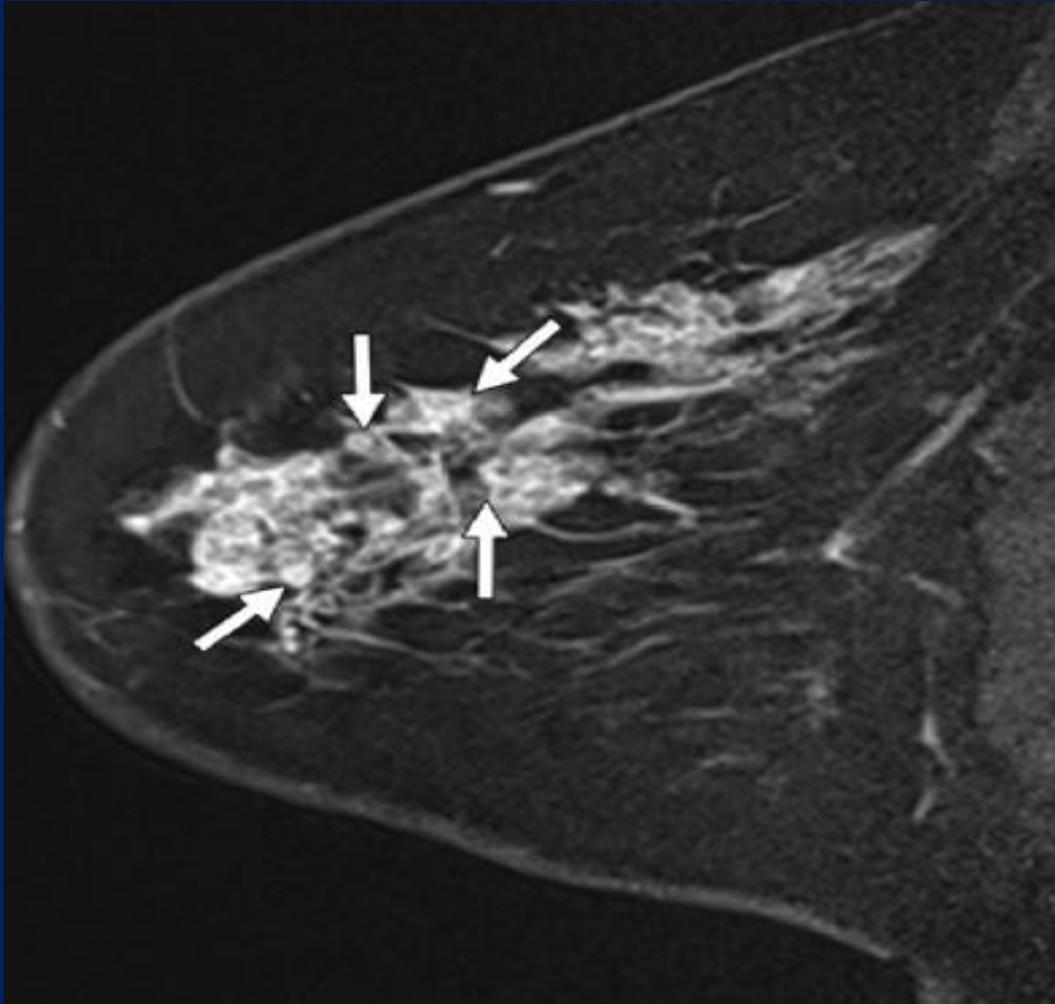
Management of NME

- 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

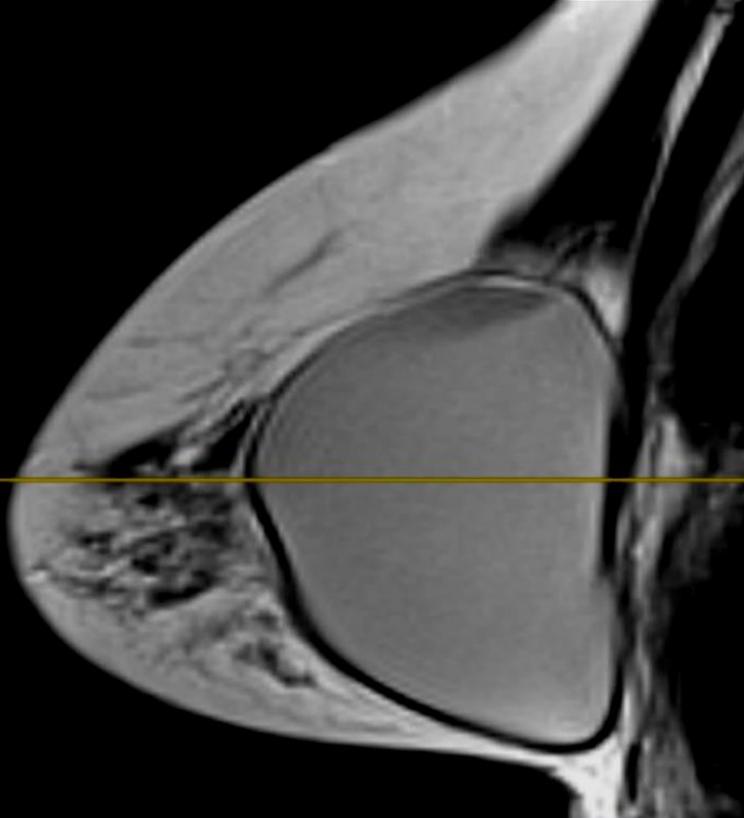
low- to intermediate-grade DCIS

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

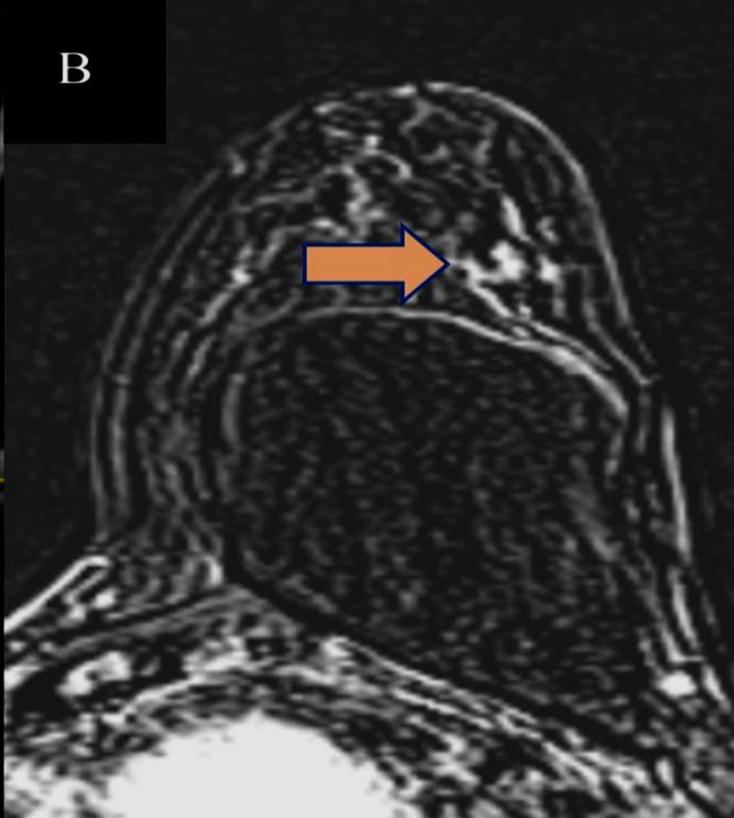
focal and **heterogeneous NME** (orange arrow).

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

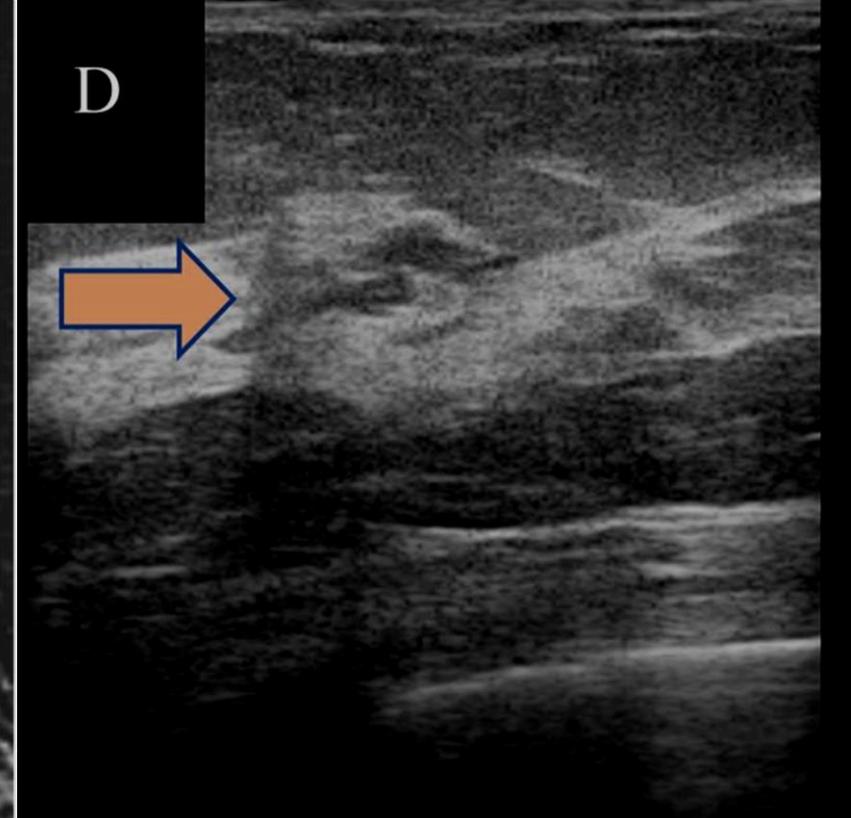
A

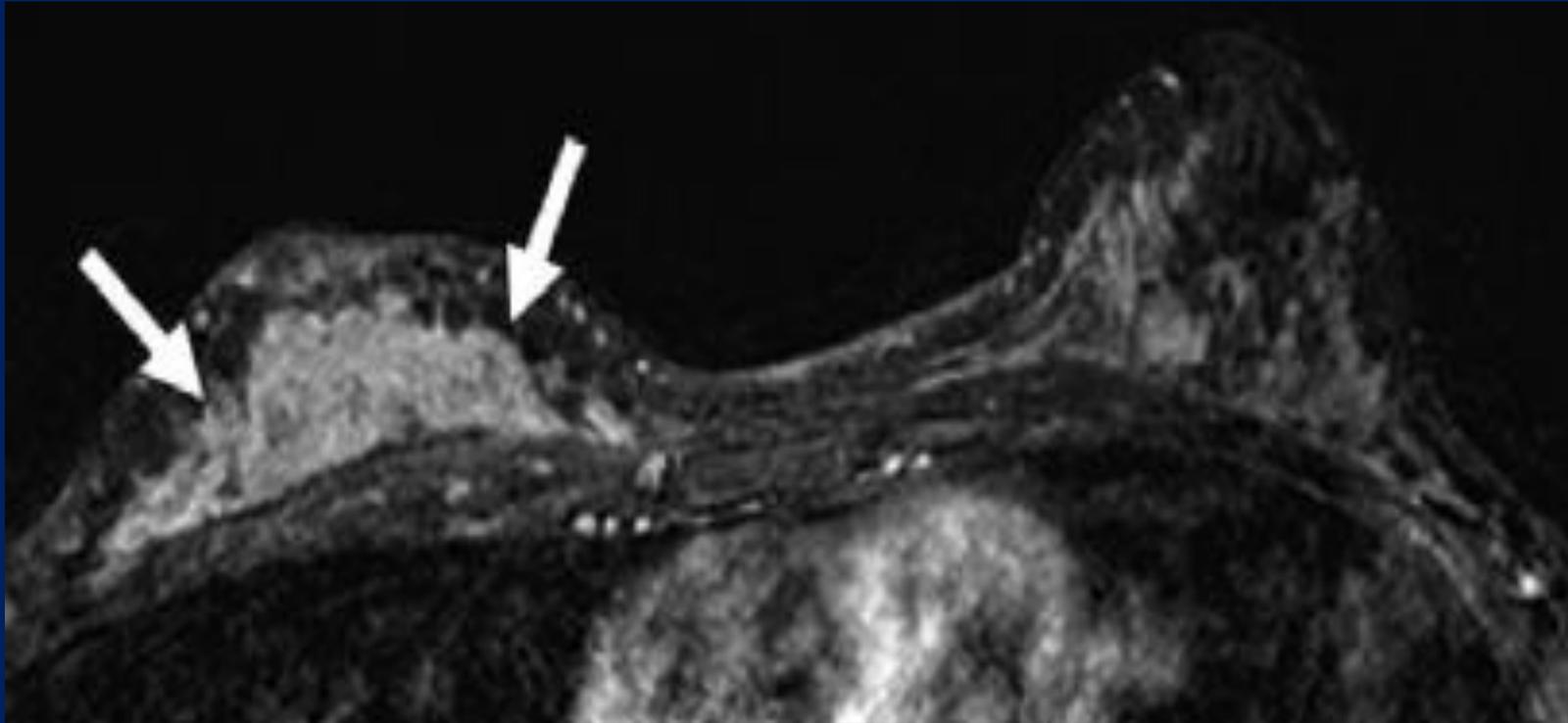


B

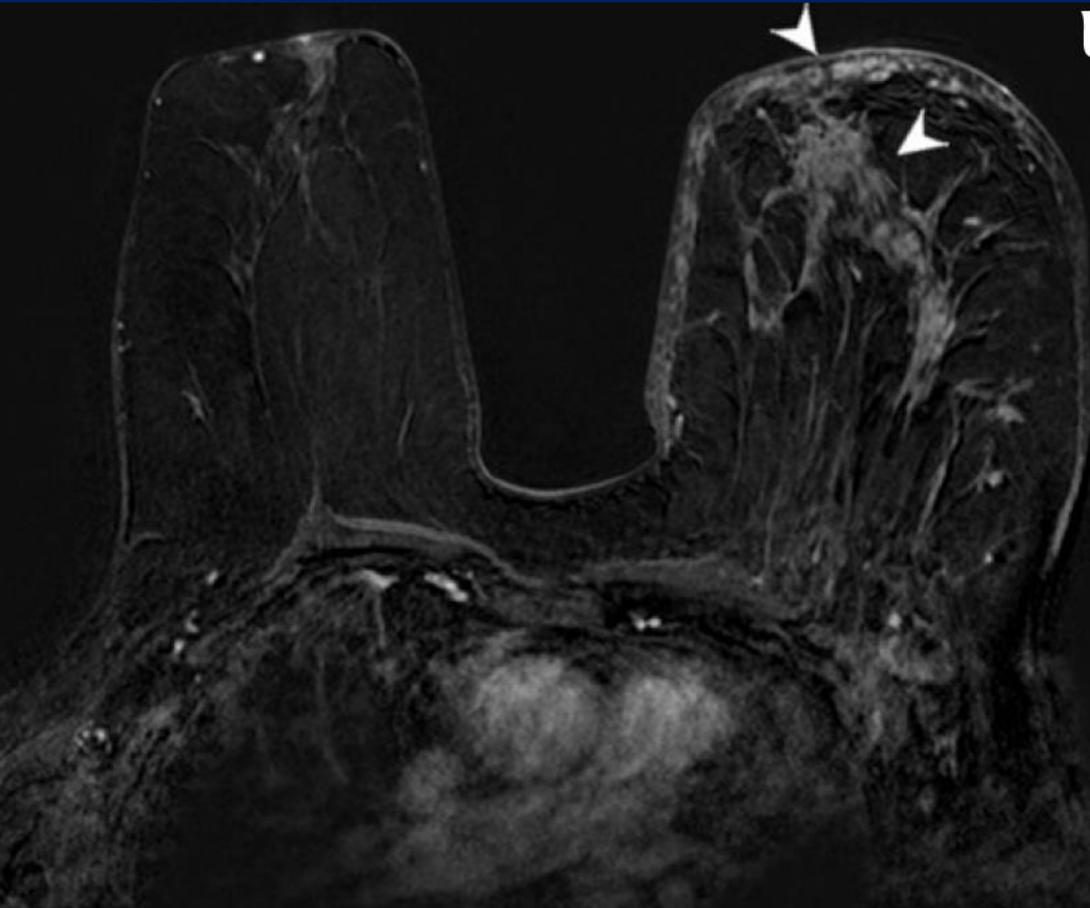


D





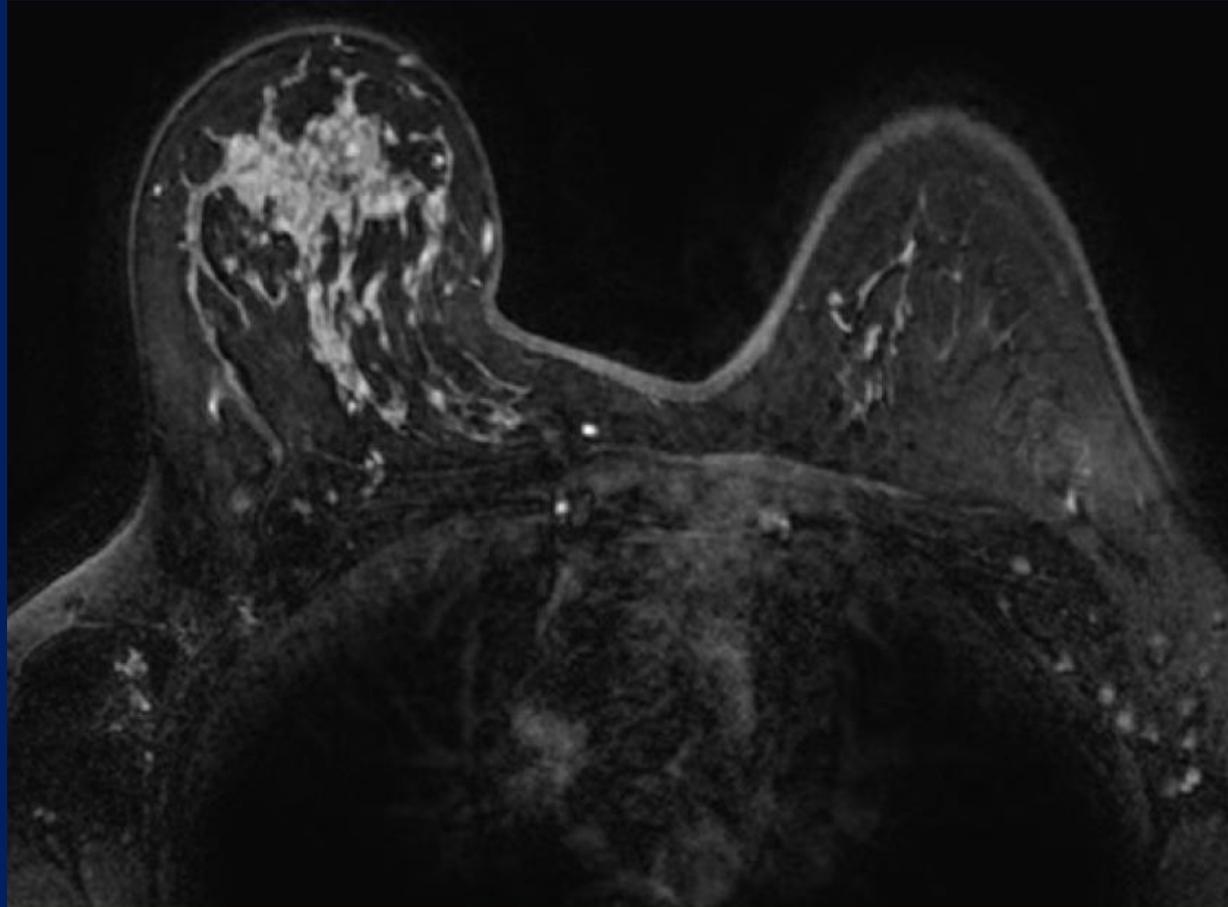
presented with a **firm right breast and flattening of the right nipple**. Axial dynamic contrast-enhanced T1-weighted fat-suppressed MR image shows **diffuse asymmetric nonmasslike** enhancement (arrows) in the right breast, with **heterogeneous** internal enhancement
diffuse invasive ductal cancer



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.**

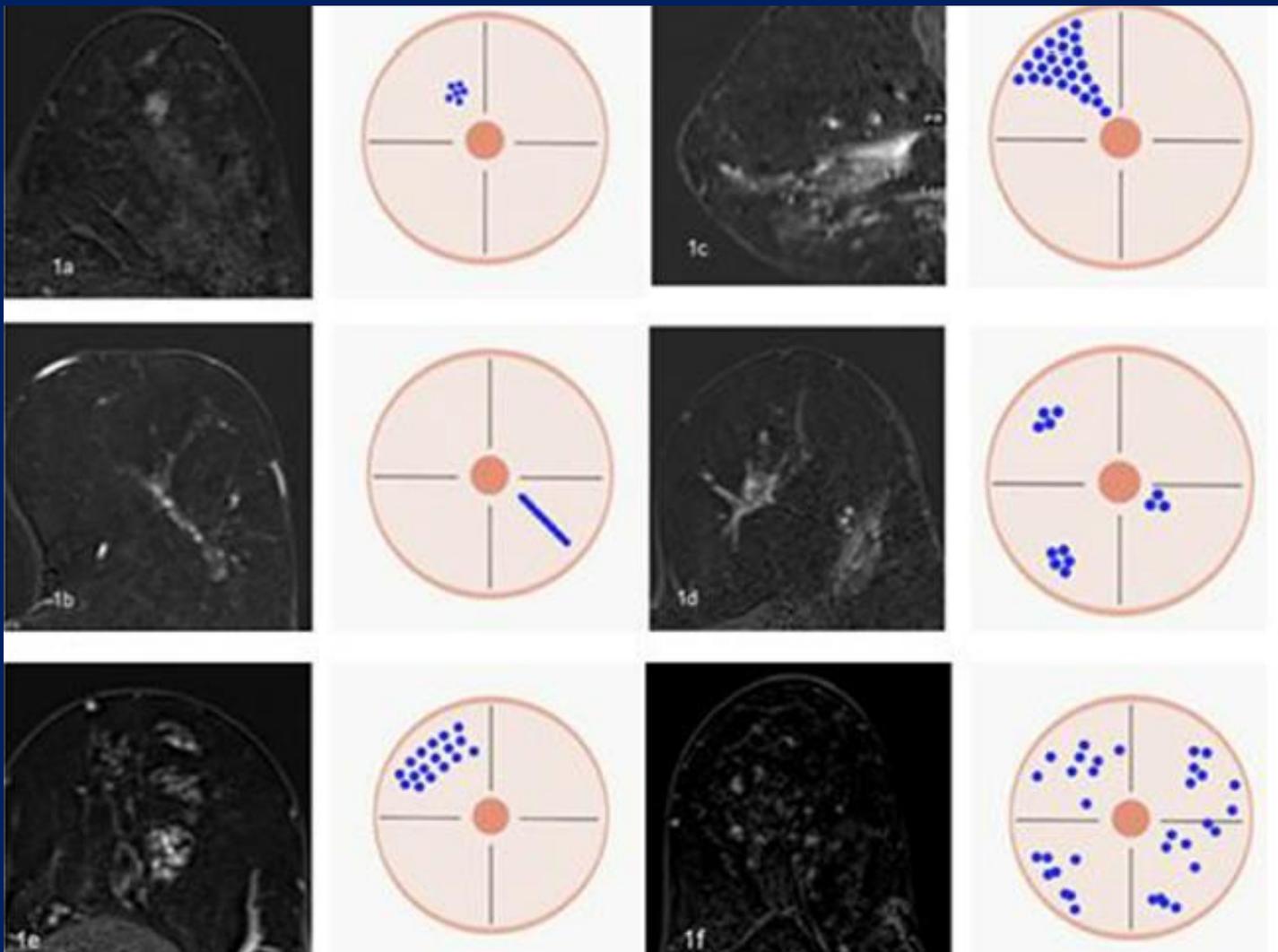
Correlation of Clinical and Imaging Findings

- 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

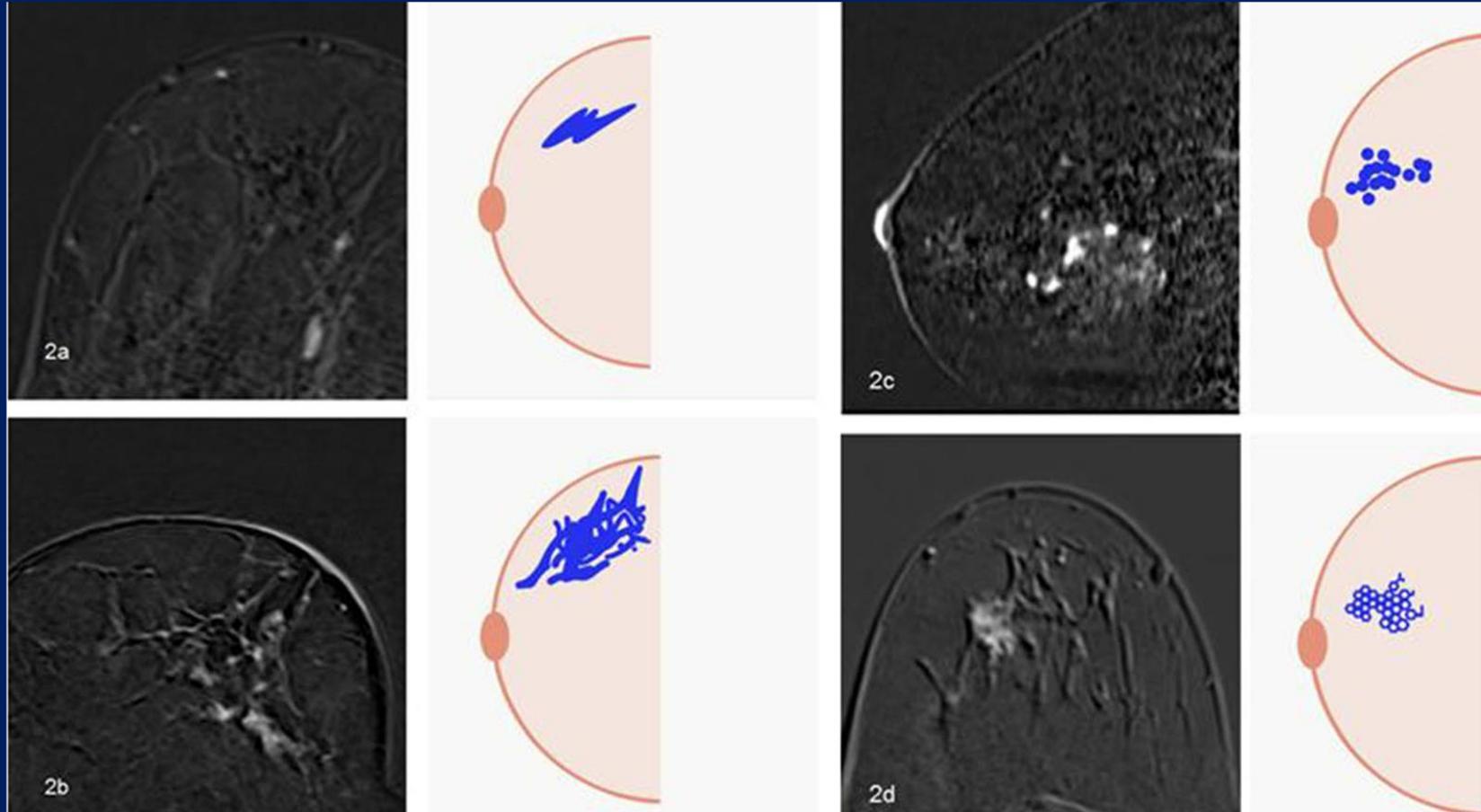
Management

- **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!