Breast Imaging

An overview for the medical student

Outline

- Facts
- Anatomy
- Imaging modalities and technique
- Screening
- BIRADS and Breast Density
- Diagnostic imaging
- Biopsy
- Breast disease in the Male population
- Cases

Breast Cancer Facts

- Most frequent cancer in U.S. women (excluding skin cancer)
- 1 in 8 women in the U.S. will be diagnosed with breast cancer during their lifetime
- 2nd highest cause of cancer deaths in women
  - Lung is the 1st highest

Anatomy

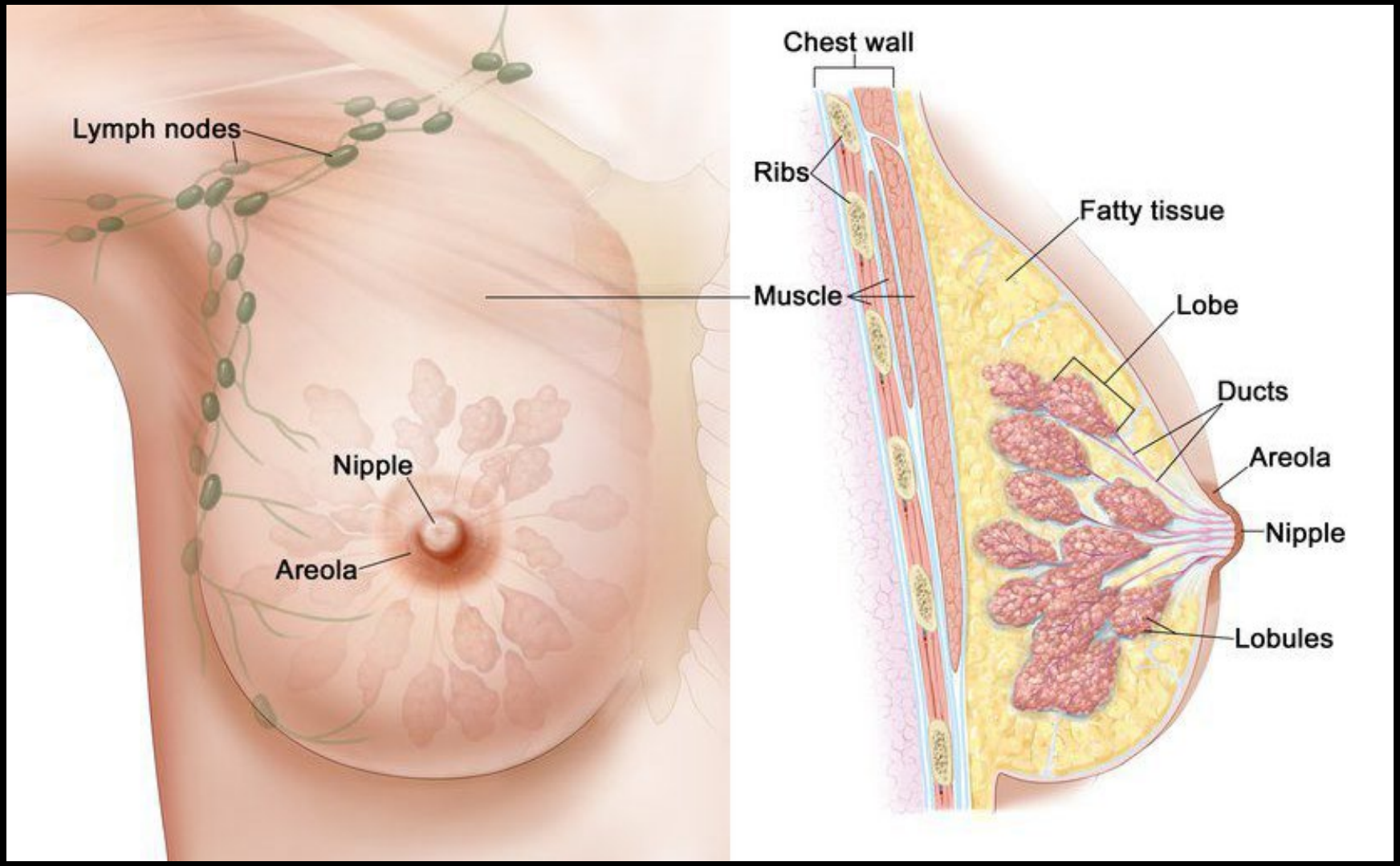


Image courtesy of National Breast Cancer Foundation

Imaging modalities and technique

The most common modalities to image the breast include

- Mammography
- Ultrasound
- MRI

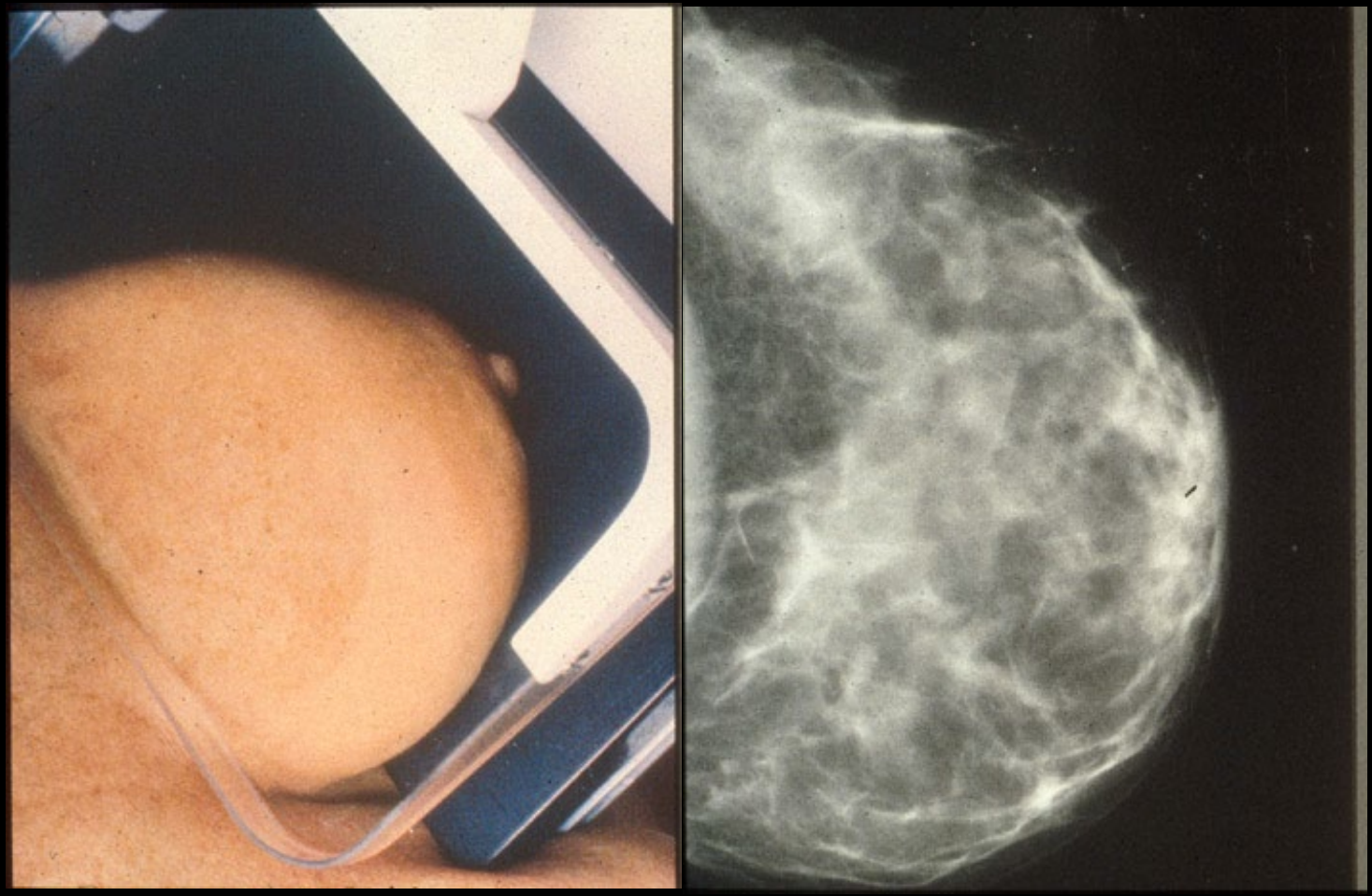
Additional modalities not discussed in detail today

- PET/CT

Mammography

- Most common screening and diagnostic tool
- Get craniocaudal (CC) and mediolateral oblique (MLO) views of each breast.
  - This allows the most tissue to imaged
- 3D tomosynthesis can be applied
  - Multiple images obtained through different parts of the breast allowing the radiologist to “scroll” through the breast, emphasizing masses and architectural distortion not easily detected with a conventional 2D approach
  - Most beneficial for women with dense breast tissue
  - Fewer unnecessary biopsies and decreases recall rates

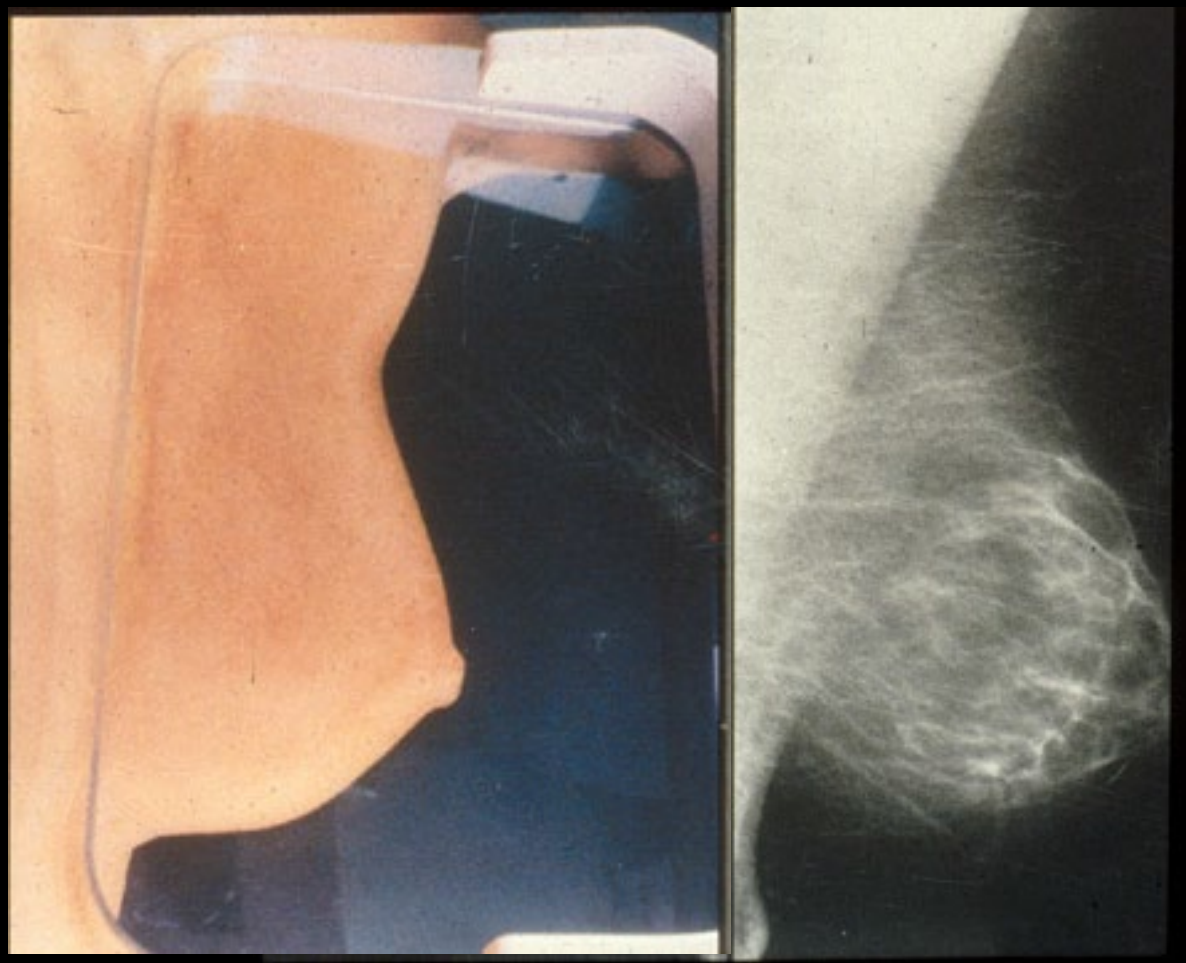
CC



lateral

medial

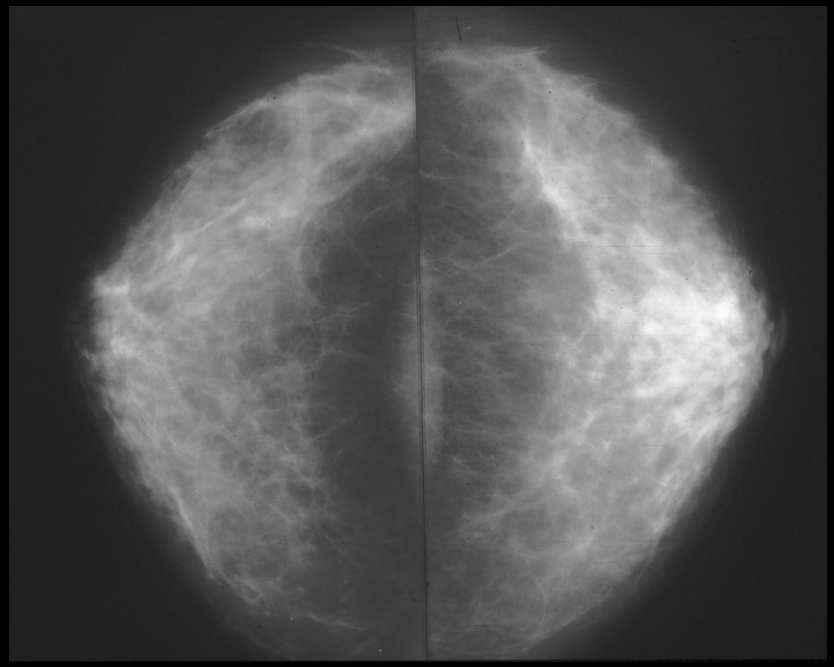
MLO



superior (head)

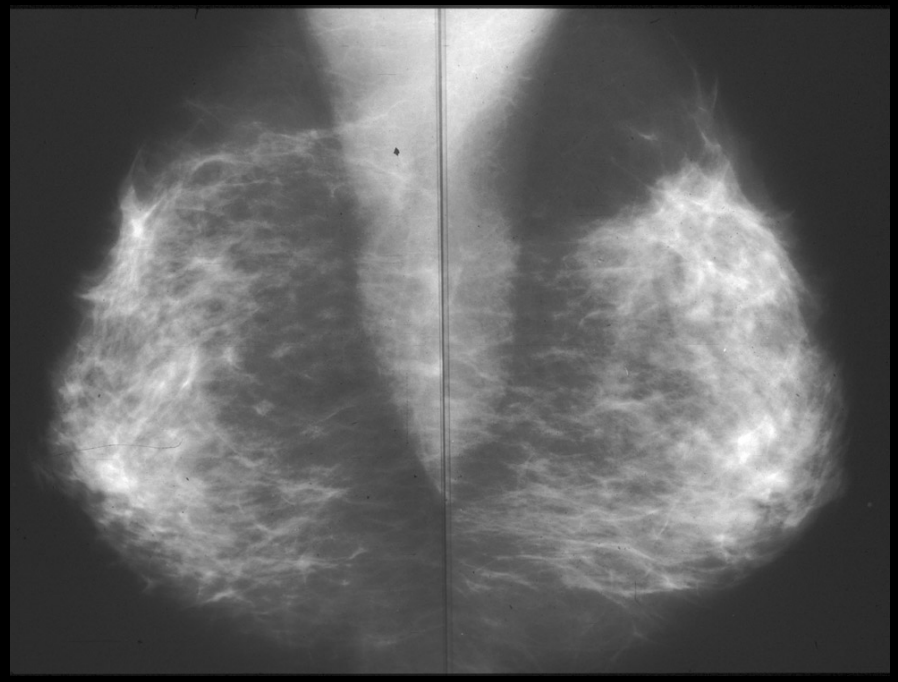
Inferior (feet)

CC, MLO



RCC LCC

RMLO LMLO



Ultrasound

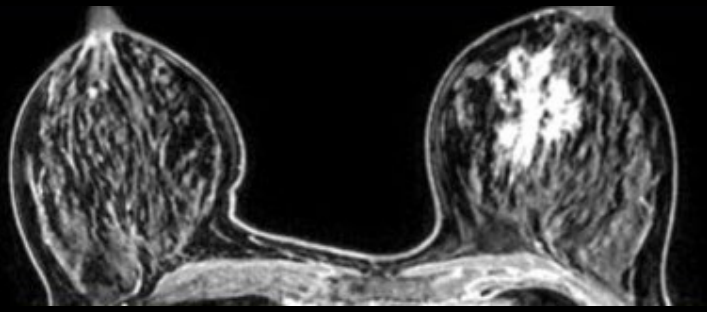
- Excellent diagnostic tool which requires no radiation, is noninvasive, and can be performed quickly at same day appointments
- Complements mammography, but should not replace mammography as the primary screening modality
  - Characterization of Palpable Abnormality
  - Characterization of Masses Detected Mammographically
  - Evaluate Areas of Focal Pain

Breast MRI

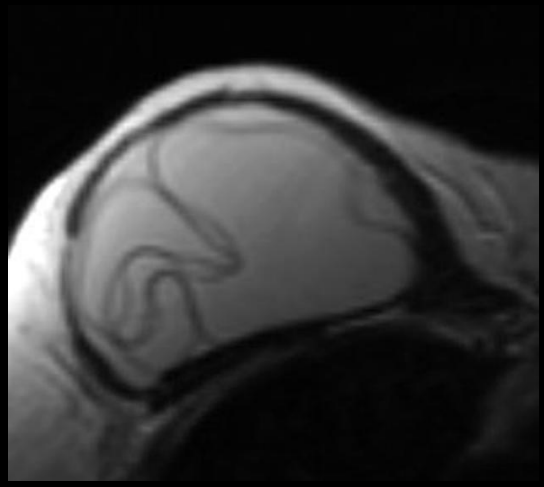
MRI

- MRI is more sensitive than mammograms and ultrasound, but not as specific
- Indications
  - Evaluate for additional sites of disease (ipsilateral extent of disease or contralateral) in cases of biopsy proven malignancy
  - Evaluating integrity of breast implants
  - Screening in high risk populations - >20% lifetime risk of breast cancer (see screening)

- MRI limitations:
  - Gadolinium contrast allergy
  - Difficult prone positioning, which may not be tolerable for all patients
  - Pacemakers, spinal stimulators, etc, which may not be MRI compatible



Left breast invasive ductal carcinoma



Intracapsular implant rupture
"Linguine sign"

Images courtesy of Radiology Assistant and Radiopeadia

General Screening Guidelines

- General Public guidelines (average risk)
  - Primary modality is mammography
  - The American College of Radiology and Society of Breast Imaging recommend:
    - Starting at age 40
    - Continue to perform annually
    - Screening can be stopped on a case by case basis per individual patient's health status
- High risk populations should consider adjunctive MRI

Additional organizations have controversial guidelines suggesting starting at 45 to 50, follow up every 1-2 years, and potentially stop screening by 74 years of age (USPSTF, ACOG, and ACS)

MRI screening

Ideal for annual screening in high risk populations which include:

- Calculated lifetime risk of 20% or more
  - Anyone with two 1st degree relatives (sister, mother, daughter) diagnosed with breast cancer
- Carries a BRCA mutation
- 1st degree relative of a BRCA carrier, but untested
- Radiation therapy to the chest received between the age 10 and 30 years, at least 8 years after completing radiation
- Genetic syndrome patients and their 1st degree relatives including
  - Li-Fraumeni
  - Cowden
  - Bannayan-Riley-Ruvalcaba

- MRI is NOT currently recommended purely on the basis of breast density. Thus, dense breasts ≠ MRI for screening.
- Women at 15-20% lifetime risk should discuss yearly MRI with their physician

2. American Cancer Society Guidelines https://doi.org/10.3322/canjclin.57.2.75

BIRADS

- Acronym for: “Breast Imaging-Reporting and Data System”
- Widely accepted classification system and reporting method which assesses risk and promotes consistency and clear communication.

BIRADS 0: incomplete; further imaging or evaluation is needed
  - also includes when previous/outside imaging has been requested

BIRADS 1: negative

BIRADS 2: benign

BIRADS 3: probably benign

BIRADS 4: suspicious abnormality

BIRADS 5: highly suggestive of malignancy

BIRADS 6: known biopsy proven malignancy

BIRADS		Likelihood of cancer	Recommendation
BIRADS 0	Incomplete	-n/a	Need priors, recall
BIRADS 1	Negative	0	Annual Mammogram
BIRADS 2	Benign	0	Annual Mammogram
BIRADS 3	Probably Benign	>0% but <2%	Short term 6 mo f/u
BIRADS 4	Suspicious abnormality	2%-95% 4a. Low suspicion >2% but <10% 4b. Moderate suspicion >10% but <50% 4c. High suspicion >50% but <95%	Biopsy
BIRADS 5	Highly suggestive of malignancy	>95%	Biopsy
BIRADS 6	Known biopsy proven malignancy	n/a	n/a

Breast Density

Required in mammogram report

- 3D tomosynthesis helpful for category B through D

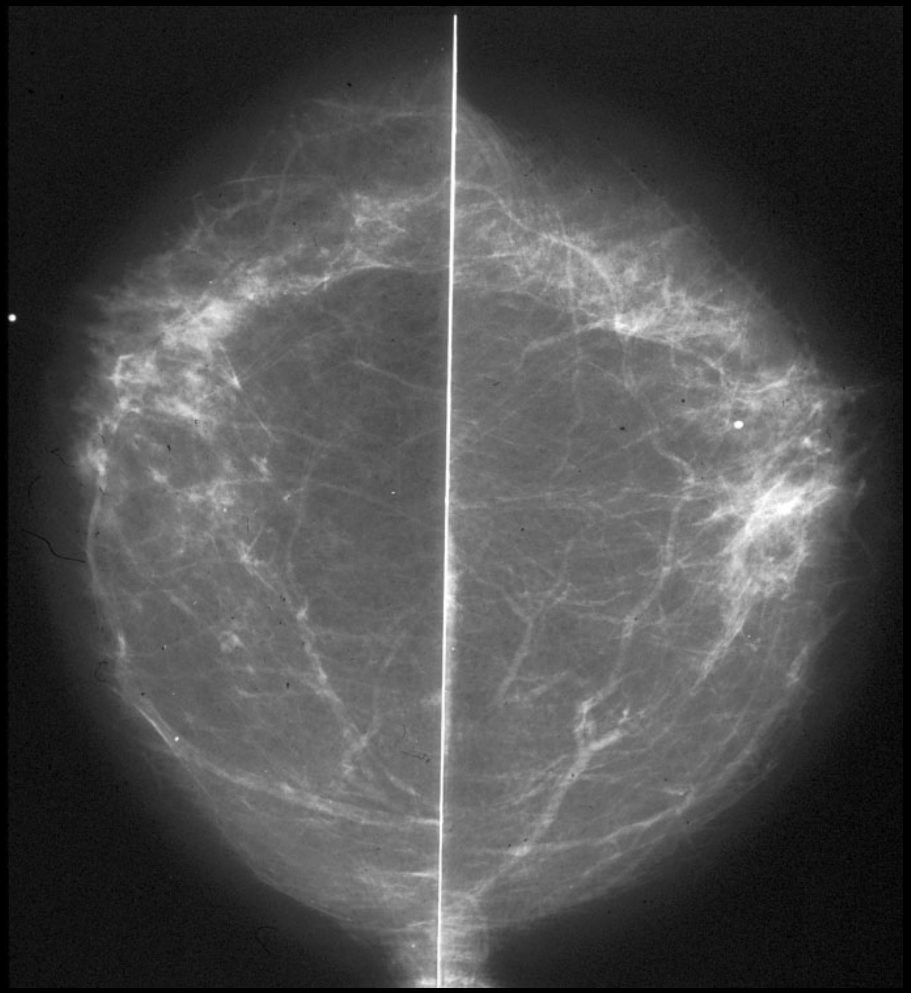
A – Almost entirely fatty

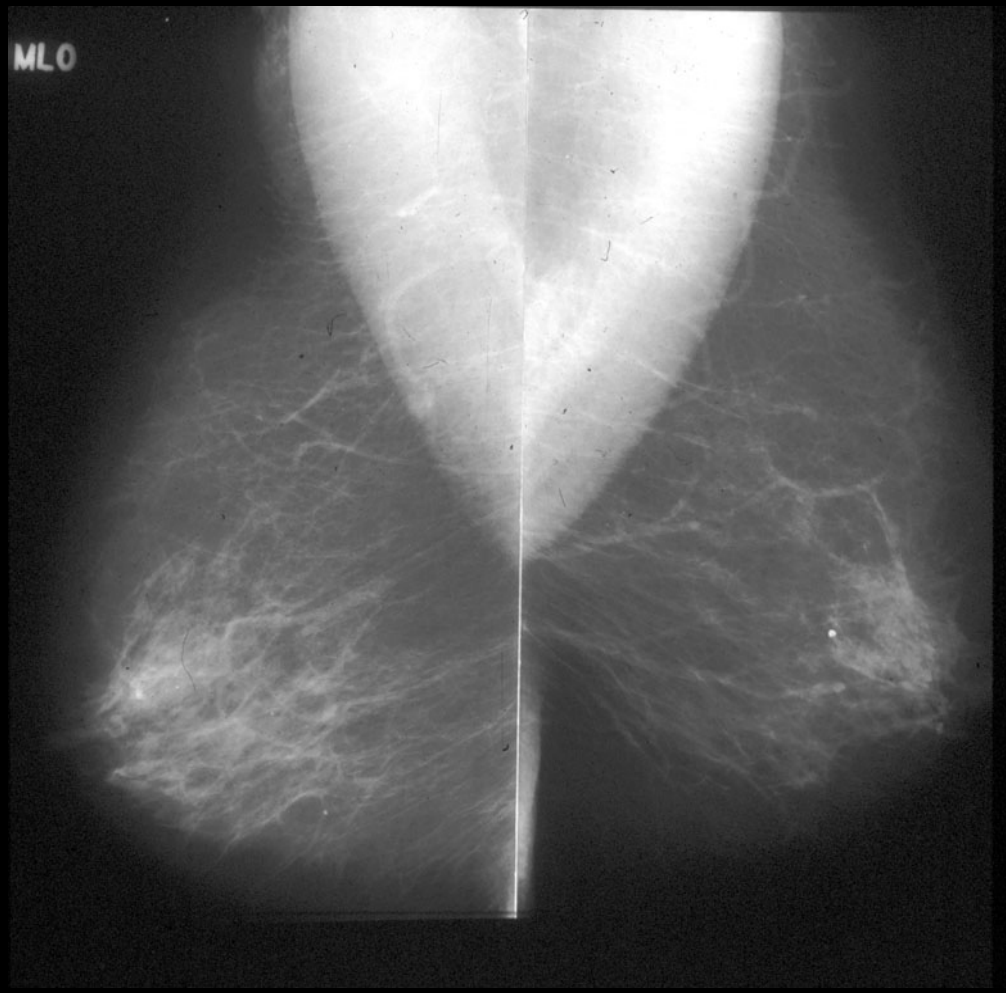
B – Scattered fibroglandular densities

C – Heterogeneously dense

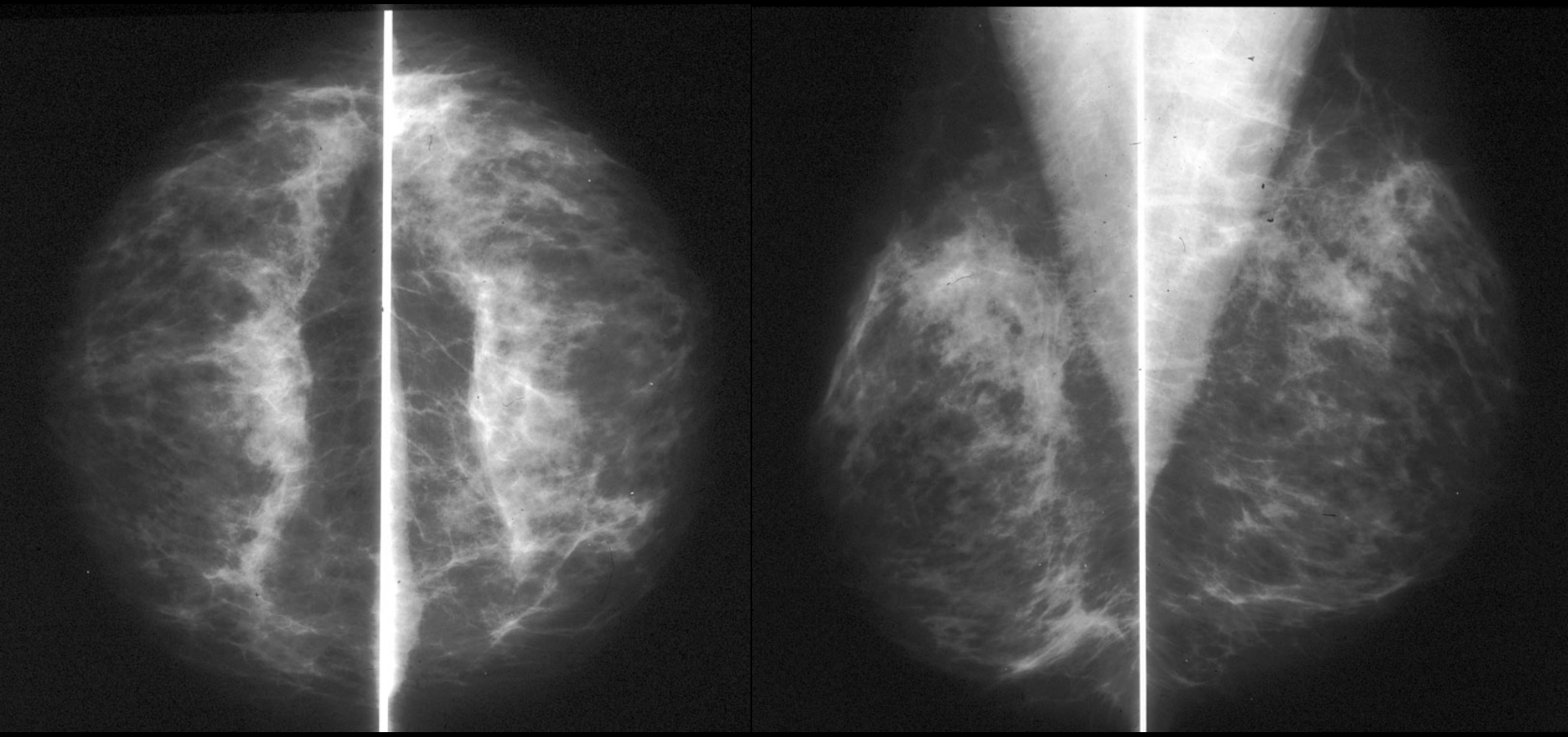
D – Extremely dense

A – Almost entirely fatty

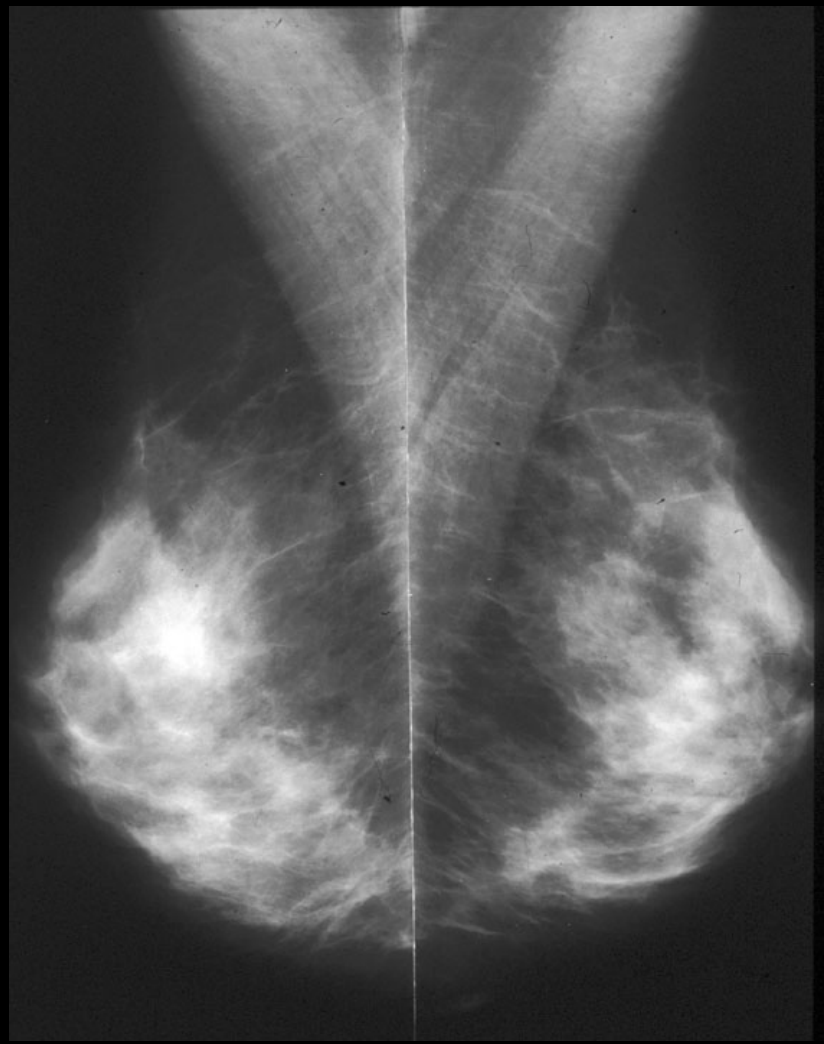




B – Scattered fibroglandular densities



C – Heterogeneously Dense



D – Extremely dense

Diagnostic imaging

- Something was found on screening mammogram
  - New or enlarging mass, suspicious calcifications, new asymmetries or architectural distortion
- Patient has focal pain
- Patient has a palpable mass
  - Under 30 years of age? → start with ultrasound
  - Over 30?
    - Not breastfeeding → start with mammogram
    - Breastfeeding → ultrasound
- If they are status post lumpectomy, their yearly "screening" will be treated as a diagnostic case for at least 7 years
  - This allows for same day additional imaging with mammogram or ultrasound, as well as a spot magnification view over the lumpectomy site.

Breast Biopsy

- Outpatient procedures using local anesthetic
- Once a suspicious area has been identified the following modalities are available to obtain tissue samples
  - Ultrasound
    - Most common for masses and lymph nodes
  - Stereotactic
    - Best for suspicious calcifications, areas of architectural distortion, and very small masses
    - Can be done in 2D or 3D
    - Can be done with patient sitting upright or laying prone
  - MRI
    - Less frequent, but sometimes necessary for findings without reliable sonographic or mammographic correlates
    - Patient needs to be able to tolerate laying prone and still for long periods of time

Breast disease in the male population

- Gynecomastia
  - Most common complaint
  - Typically painful and usually bilateral
  - Mammogram +/- US can further assess
  - May point to hormonal imbalances or side effects to drug
  - Some cases may require surgical excision for cosmetic/symptom relief
- Breast Cancer
  - "Male breast cancer makes up less than 1% of all cancers in men and less than 1% of all breast cancers in the United States"[6]
  - Detection is usually delayed, thus typically presents at a later stage
  - Like in women, genetic mutations like BRCA significantly increase the risk of breast cancer in men and routine screening can be considered

Cases

Case 1

- A 35 yo female with cyclical unilateral lower axillary fullness and tenderness without focal palpable mass.

What mammographic finding would best explain her symptoms?

A. High density lymph nodes
B. Adenopathy
C. Irregular mass
D. Axillary breast tissue

Case 1

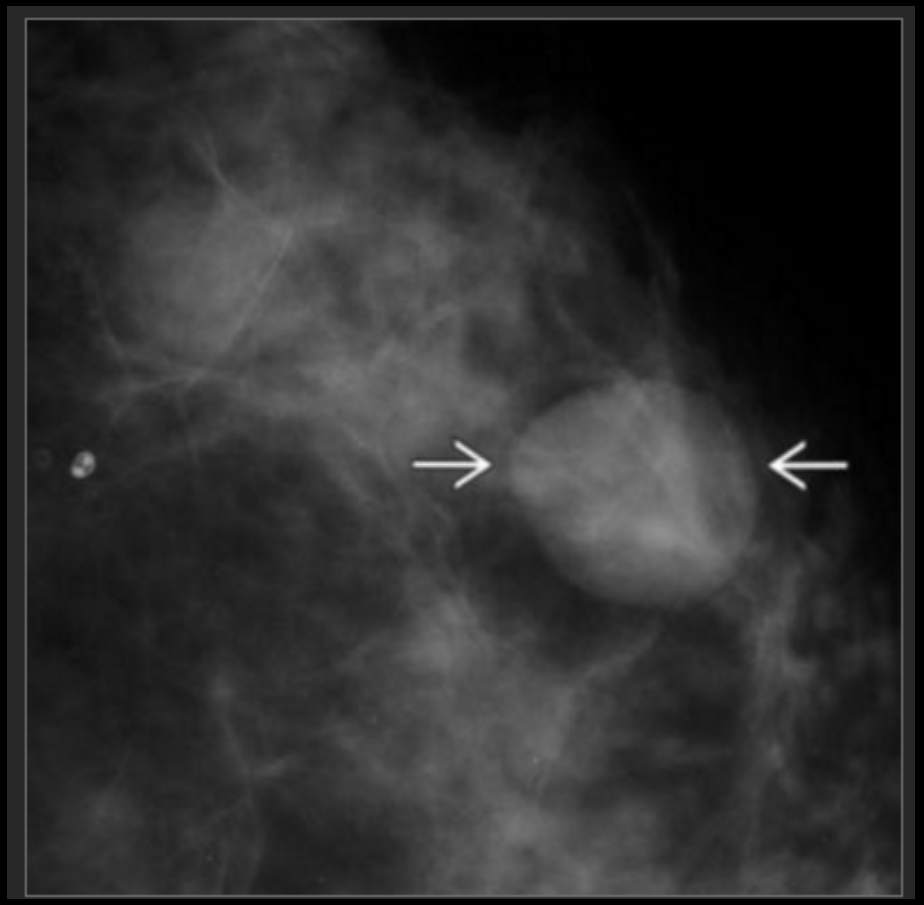
- A 35 yo female with cyclical unilateral lower axillary fullness and tenderness without focal palpable mass.

What mammographic finding would best explain her symptoms?

A. High density lymph nodes
B. Adenopathy
C. Irregular mass
D. Axillary breast tissue
   - Usually asymptomatic, but can present with cyclical pain and fullness related to menses.

Case 2

- 45 y/o F with new mass on annual screening mammogram.



What is the next step?

A. 6 mo. f/u diagnostic mammogram
B. Ultrasound for further evaluation
C. Stereotactic Biopsy
D. MR guided Biopsy
E. Return to screening

B. Ultrasound for further evaluation

What is the diagnosis?

A. Simple cyst
B. Fibroadenoma
C. Cancer
D. Papilloma

A. Simple cyst

What next?

A. Biopsy
B. Do nothing. Return to screening population.
C. If symptomatic, aspirate. If asymptomatic, do nothing and return to screening.
D. Surgical consult for surgical excision.

C. If symptomatic, aspirate. If asymptomatic, do nothing and return to screening.

Patient was symptomatic. Cyst aspirated with return of yellow/green fluid. Cyst collapsed/disappeared. What next?

A. Discard fluid. Return to screening.
B. Send fluid for cytology.
C. Biopsy

Answer: A. Discard fluid. Return to screening.

- Only sanguineous fluid is worrisome and sent for cytology.
- Or if cyst cannot be completely aspirated/has solid component.

Case 3

- A PET/CT was performed and an FDG-avid breast mass was identified.

Which of the following is NOT an indication for PET/CT in breast imaging?

A. Screening
B. Staging
C. Restaging
D. Response to therapy

Case 3

- A PET/CT was performed and an FDG-avid breast mass was identified.

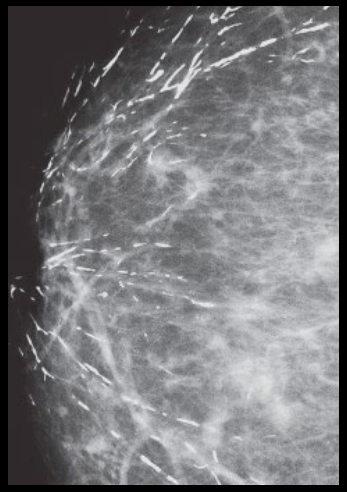
Which of the following is NOT an indication for PET/CT in breast imaging?

A. Screening
   - Mammography is the gold standard for screening.
   - High risk patient? – add Breast MRI.
B. Staging
C. Restaging
D. Response to therapy

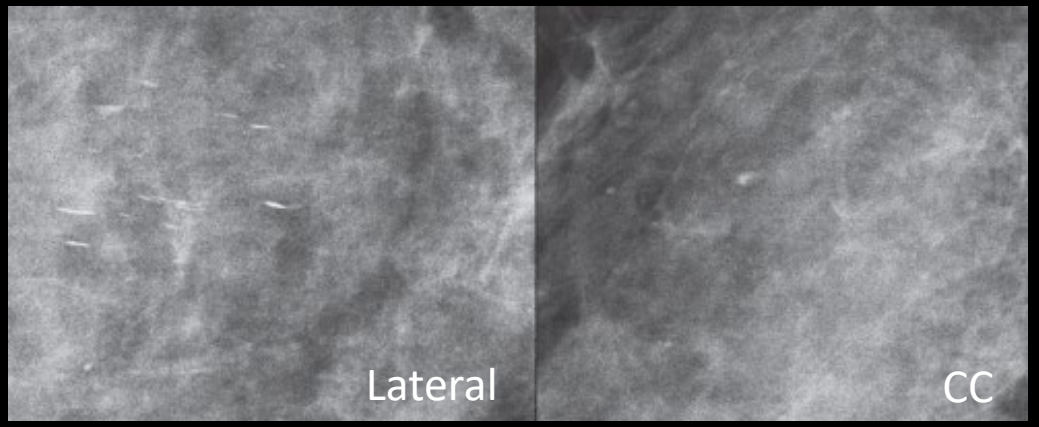
Case 4

Which of the following calcifications requires biopsy (BIRADS 4)?

A

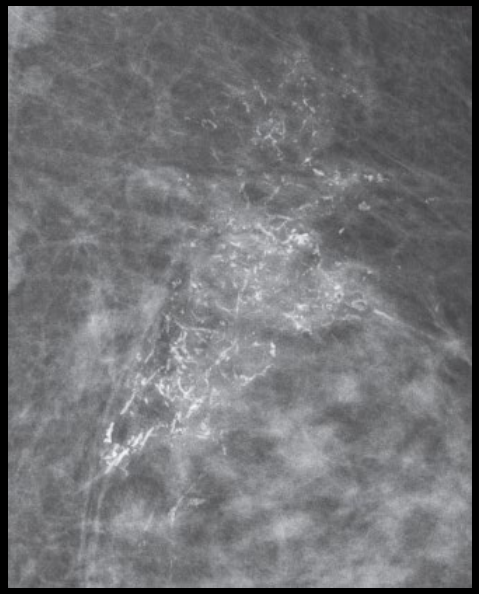


B



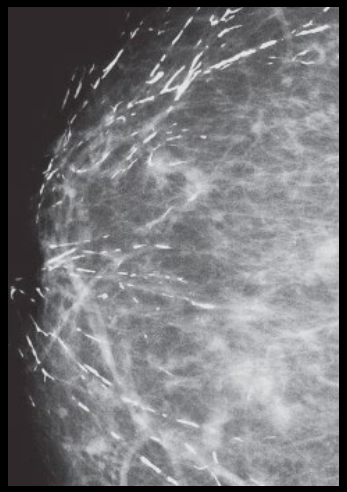
C

D

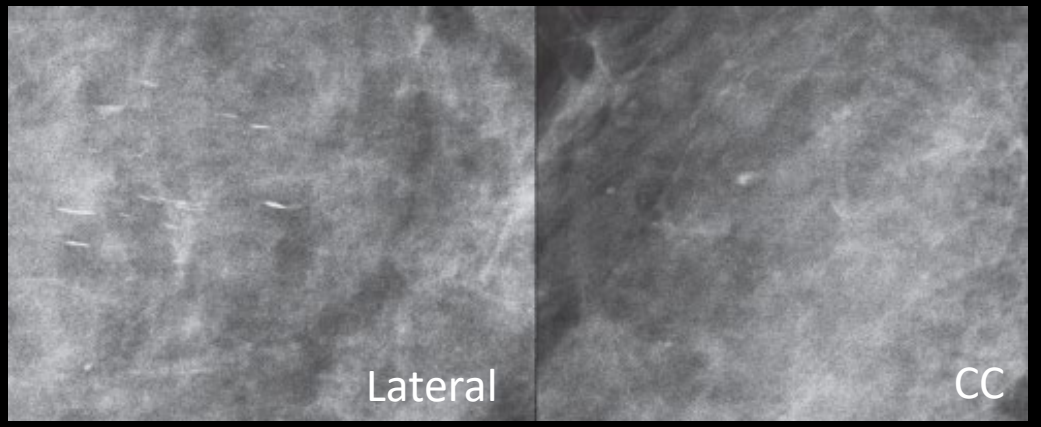


Case 4

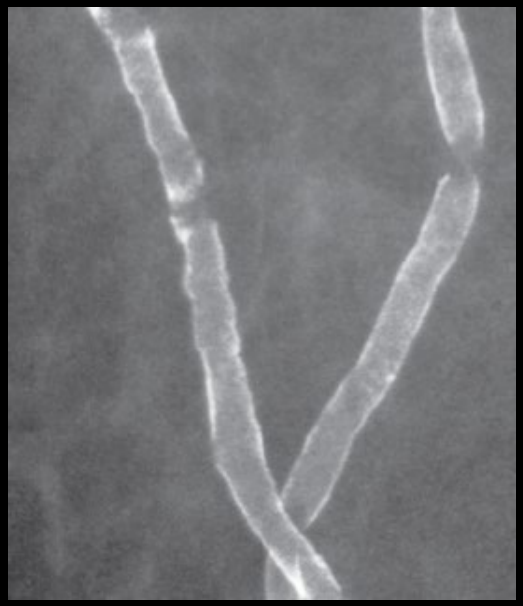
Which of the following calcifications requires biopsy (BIRADS 4)?



A. Secretory
Diffuse, large rod-like
Projects towards nipple

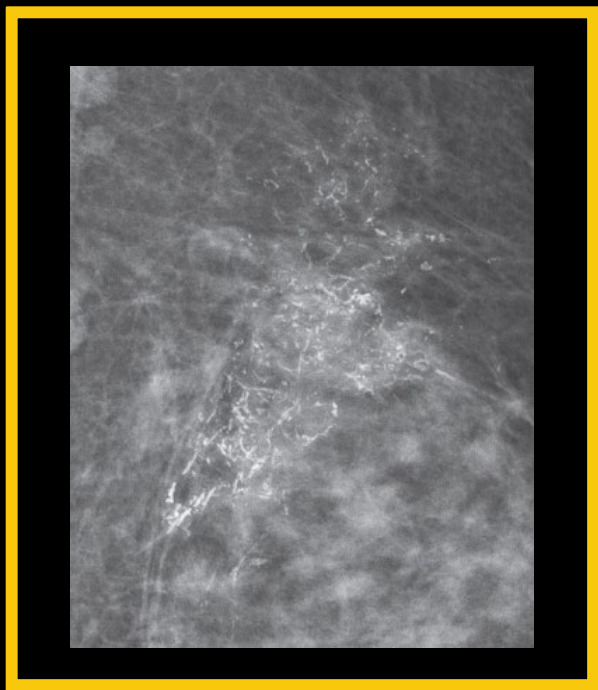


B. Milk of Calcium. Note change in shape with positioning, layering on true lateral



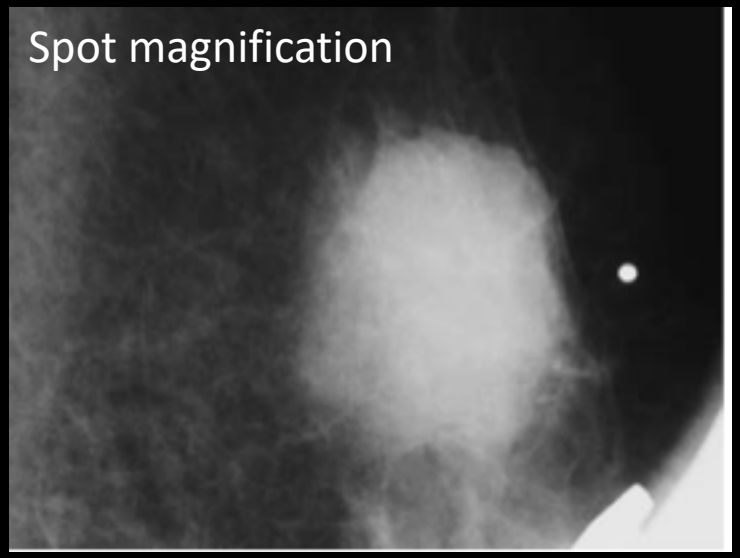
C. Vascular
"train tracks"

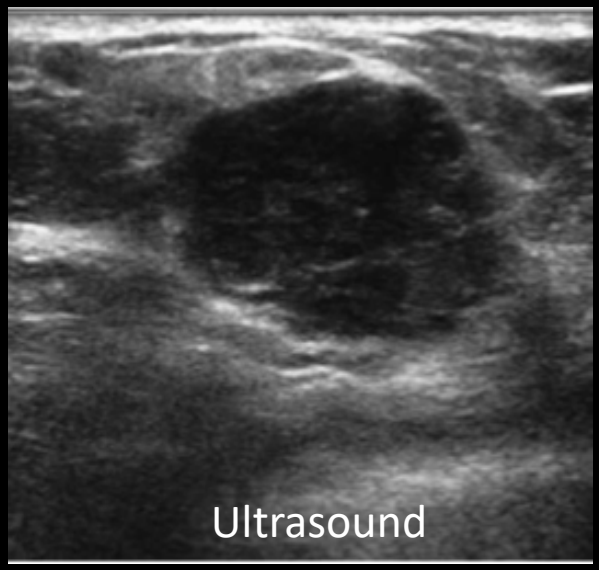
D. Suspicious
Fine, pleomorphic
Segmental distribution



Case 5

52 yo female, asymptomatic. Recall from screening mammogram.





A. Cyst
B. Normal fibroglandular tissue
C. Invasive breast cancer
D. Normal lymph node

Case 5

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B. Normal fibroglandular tissue
C. Invasive breast cancer
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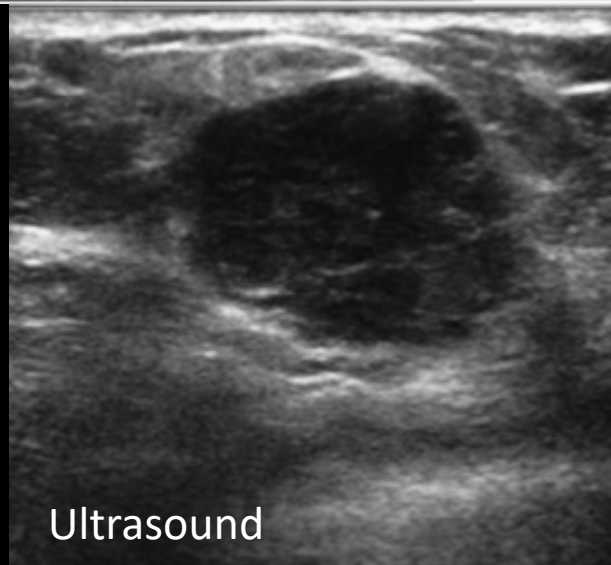
Spot magnification demonstrates mass with:
- Oval shape
- Indistinct margin
- High density

On same day ultrasound:
- Oval, angular/microlobulated margins
- Heterogeneously hypoechoic

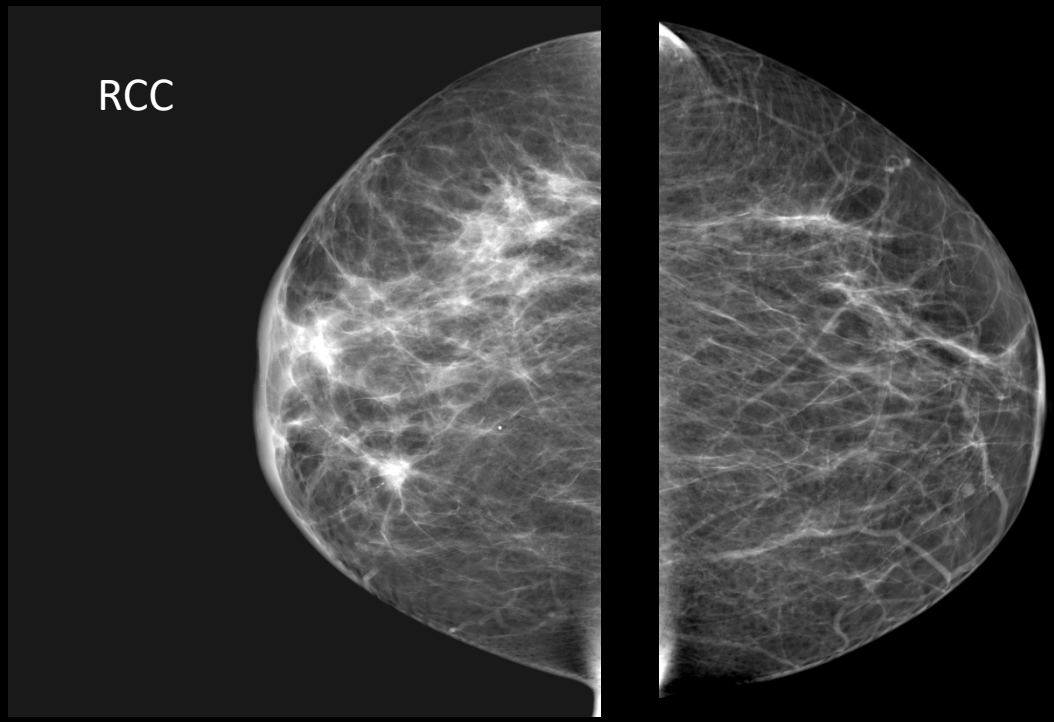


Types of Invasive Breast Cancer

- Most common
  - Ductal
    - Invasive ductal NOS
    - Tubular
    - Papillary
    - Mucinous
    - Medullary
  - Lobular
    - Invasive lobular
- Less common
  - Stromal
    - Phyllodes
    - Angiosarcoma
    - Adenoid cystic carcinoma
    - Osteosarcoma
  - Metastatic Disease
  - Other
    - Leukemia
    - Rhabdomyosarcoma

Case 6

64 y/o F with diffuse asymmetric right breast skin thickening, developed within the last several weeks.



A. Skin thickening secondary to edema from systemic cause (heart failure, other volume overload state)
B. Mastitis versus inflammatory breast cancer
C. Normal finding due to aging
D. Mondor Disease (thrombophlebitis)

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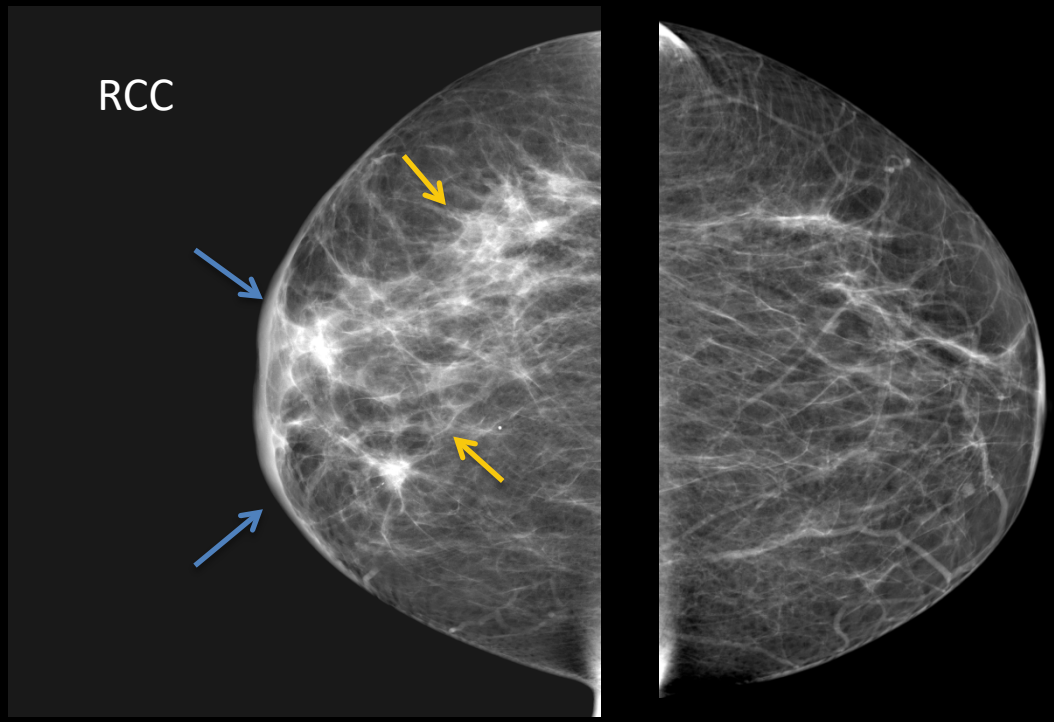

A. Skin thickening secondary to edema from systemic cause (heart failure, other volume overload state)
B. Mastitis versus inflammatory breast cancer
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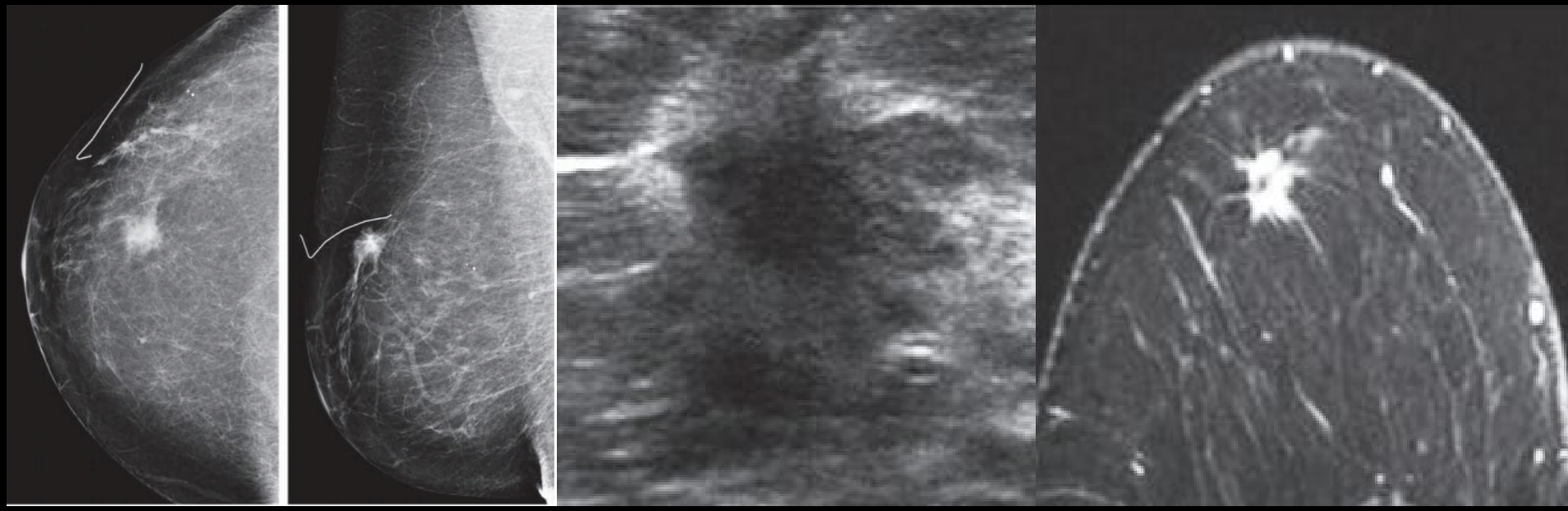
B. Mastitis versus Inflammatory Breast Cancer

- Mastitis can present at any age, but is more common in breast feeding patients
  - Recommend continued breast feeding
  - Can trial a course of antibiotics, but if symptoms don't resolve further evaluation is required
    - Ultrasound to exclude abscess
    - Skin punch biopsy to exclude inflammatory breast cancer
- Inflammatory Breast Cancer
  - Additional presentation of invasive ductal
  - May initially "respond" to ABx but will not resolve
  - Usually does not have a distinct mass on mammogram
  - Higher risk of metastasis: check for abnormal lymph nodes

Case 7

55 y/o F. Asymptomatic. Recall from screening mammogram.



A. Normal lymph node
B. Lipoma
C. Invasive lobular carcinoma
D. Simple cyst

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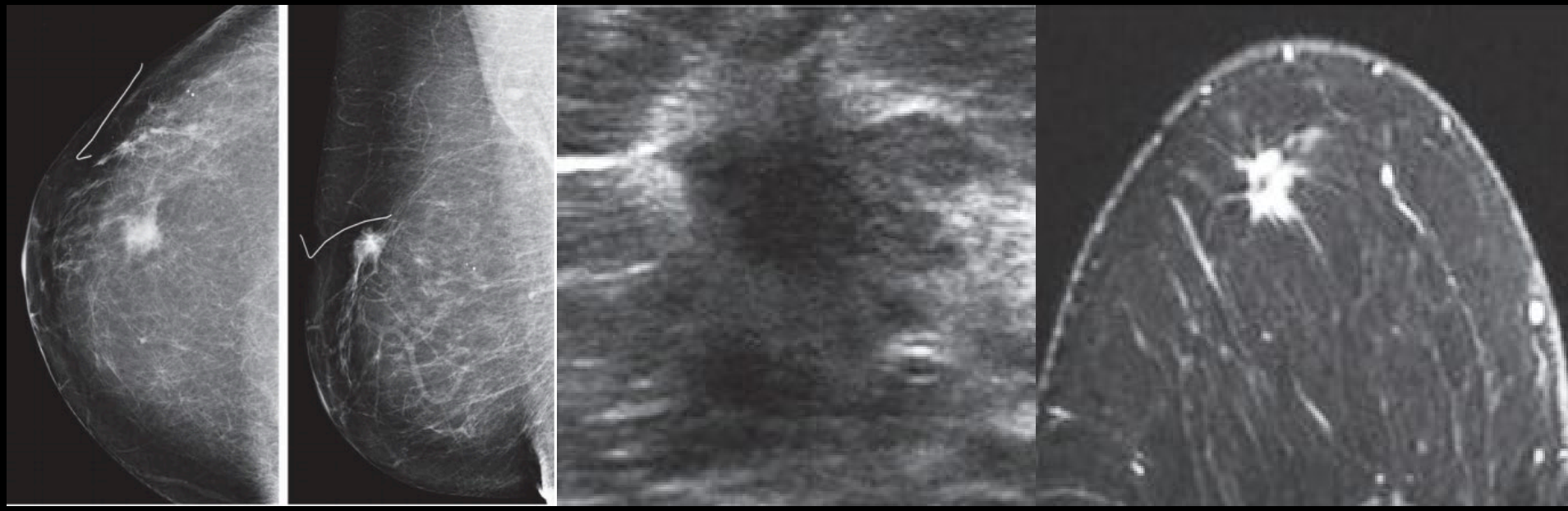

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Spiculated margins on mammogram, ultrasound, and MRI = WORRISOME

On ultrasound – hypoechoic mass with irregular margins and posterior shadowing

Additional pointers to look like a Pro

- Send skin lesions to Derm, not Mammo (A zit on the breast is still a zit)
- No one recommends mammograms prior to age 25, even in very high risk patients
- Be clear on what constitutes a “STRONG” family history: first degree relative(s) *prior* to menopause
- **Bilateral or diffuse breast tenderness is not an indication for diagnostic mammography** outside of a routine screening examination if the patient is due for one

THANKS!

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