

# 432 Radiology Team



## (2): Radiology of the breast

\* Many thanks to 431 team for their helpful notes \*



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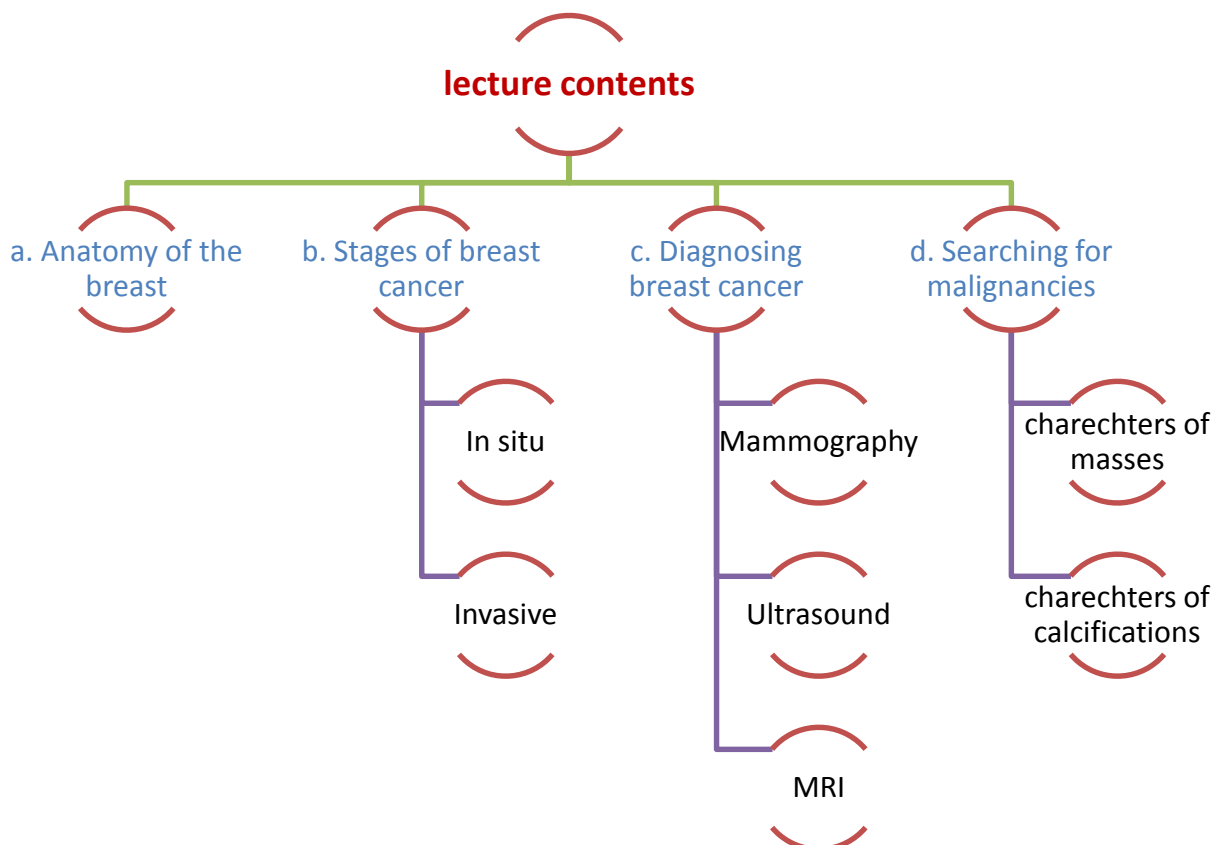
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**COLOR GUIDE:** • Females' Notes • Males' Notes • Important • Additional • 431 team

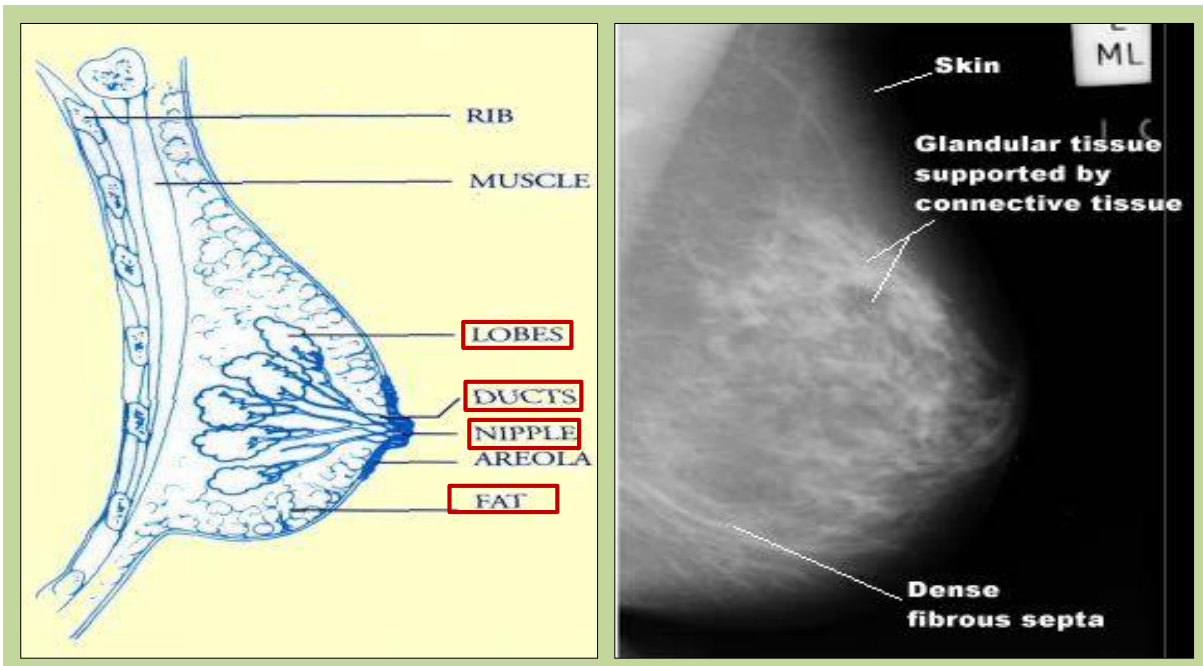
# 🎯 Objectives 🎯

1. To understand the anatomy of the breast radiology/imaging based.
2. To highlight the suitable modality for age and disease of the breast.
3. To understand the role of radiology in diagnosing breast lesions particularly breast cancer.

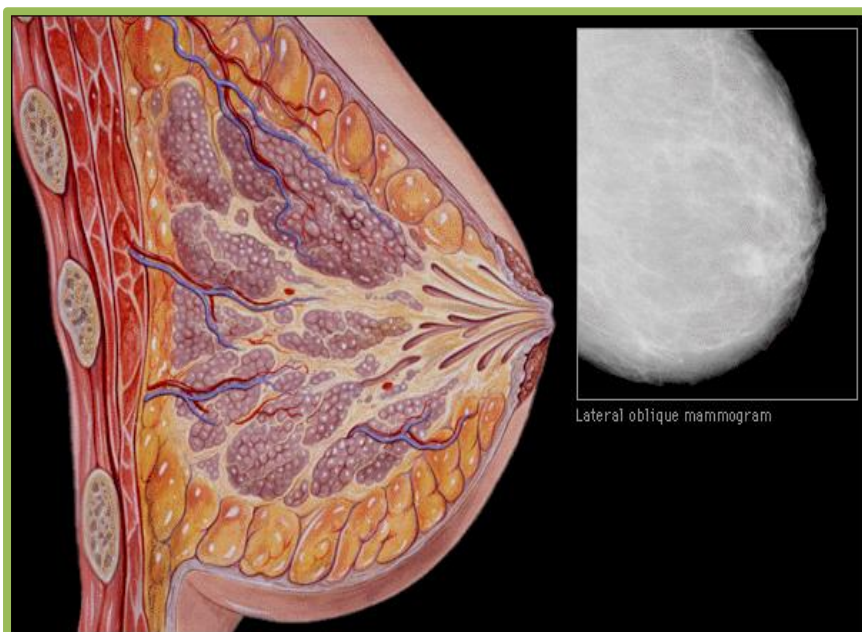


## a. Normal Anatomy of the Breast (from radiological POV)

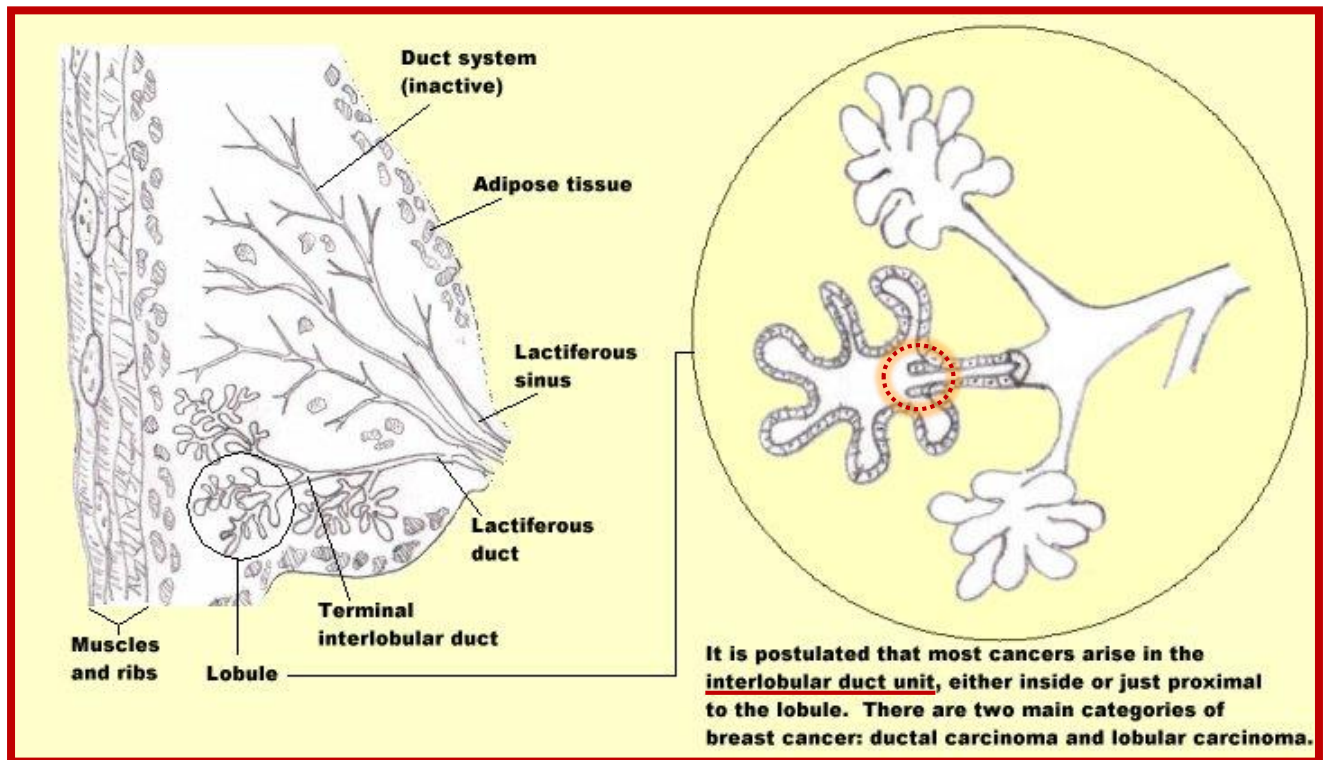
- Breast is a glandular organ contained in fat.
- The glandular tissue consist of lobes and lobules draining into ducts. The ducts connect the mammary glands to the nipple *(we cannot see these details in imaging. Look at the picture below)*
- In mammography, what you can see in grey is the fat, while the glandular tissue is dense. The more the glandular tissue the patient has, the denser the breast. *(put this in your mind, we'll discuss it later)*



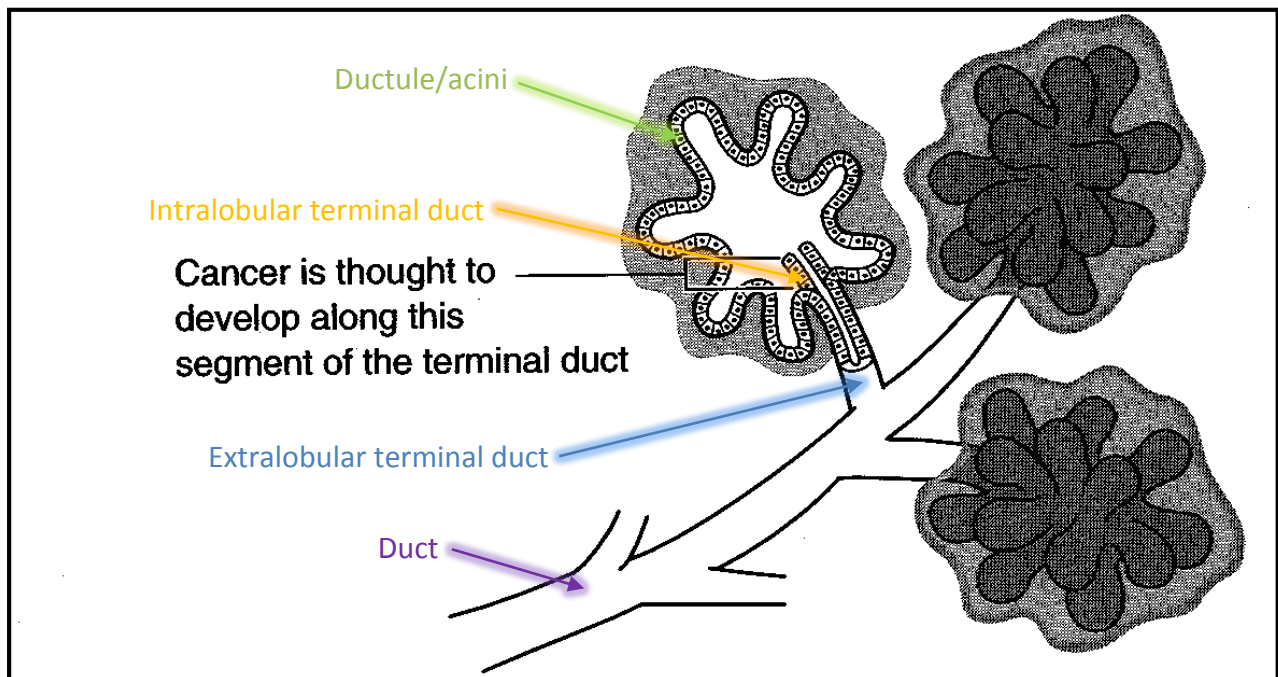
- Mammogram of a normal breast ↓



- The most proximal part of the ducts is called: *Terminal interlobular duct* (or *terminal ductal lobular unit -TDLU-*), which is connected to the lobules directly. You should know it because 95% of the malignancies arise from this unit.



- The epithelium inside the lobules is *histologically distinct* from the epithelium in the extralobular ducts ↓



## b. Breast cancer stages:

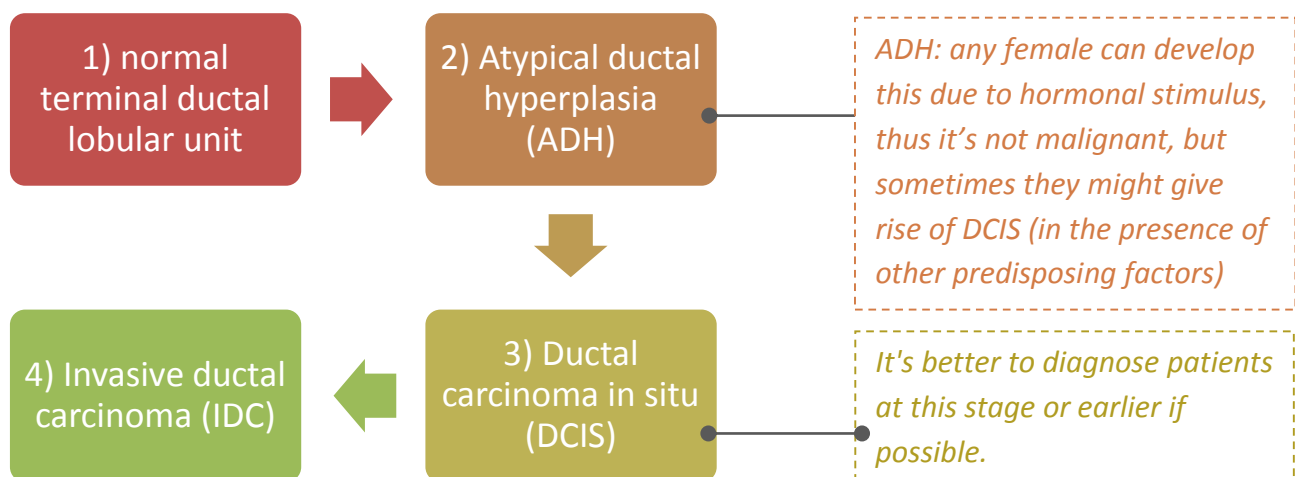
**1- In situ:** Tumor cells have **NOT** invaded the **basement membrane**.

tumor cells remain confined to the ducts or lobules (*our aim is to diagnose malignancies as early as being in situ to achieve better prognosis, less complications and less morbidity and mortality*)

**2- Invasive:** Tumor cells **invade** the breast stroma.

They have the potential to metastasize and result in death of the patient.

*Clinical and molecular research have demonstrated that there is likely often a linear progression of sequential stages of epithelial proliferation:*



## c. Diagnosing of Breast cancer:

***There are 4 pillars of diagnosis:***

1 - Clinical or self-examination (*most of physicians examine high risk patients e.g. positive family history*)

2 - Mammography

3 - Ultrasound

4 - MRI

*To summarize the role of imaging: to prove or disprove the presence of cancer.*

**Menu of available tests:**

1 - Mammography: Can rule IN cancer, but can NOT rule it OUT.

2 - Ultrasound: Especially in young age

*(15-45 years are considered young age. You cannot use mammography for a young female, because she has a dense breast normally (full of glandular tissue); remember: malignancy also looks dense on mammography, so it'll be hard to differentiate between the mass and the normal tissue. That's why ultrasound is preferred in this case. With aging, the breast becomes more fatty. Menopausal patients don't have a lot of glandular tissue so you can detect malignancies much easier → use mammography for them)*

3 - CT scan (with and without contrast): not for detecting the cancer, but after diagnosing a cancer patient you might use it for staging (presence or absence of metastasis e.g. lung metastasis)

4 - MRI (with and without contrast - gold standard with contrast): *used for high risk **young** patients when ultrasound is negative.*

5 - Ultrasound or MR-guided biopsy and wire localization

6 - Bone radionuclide scan

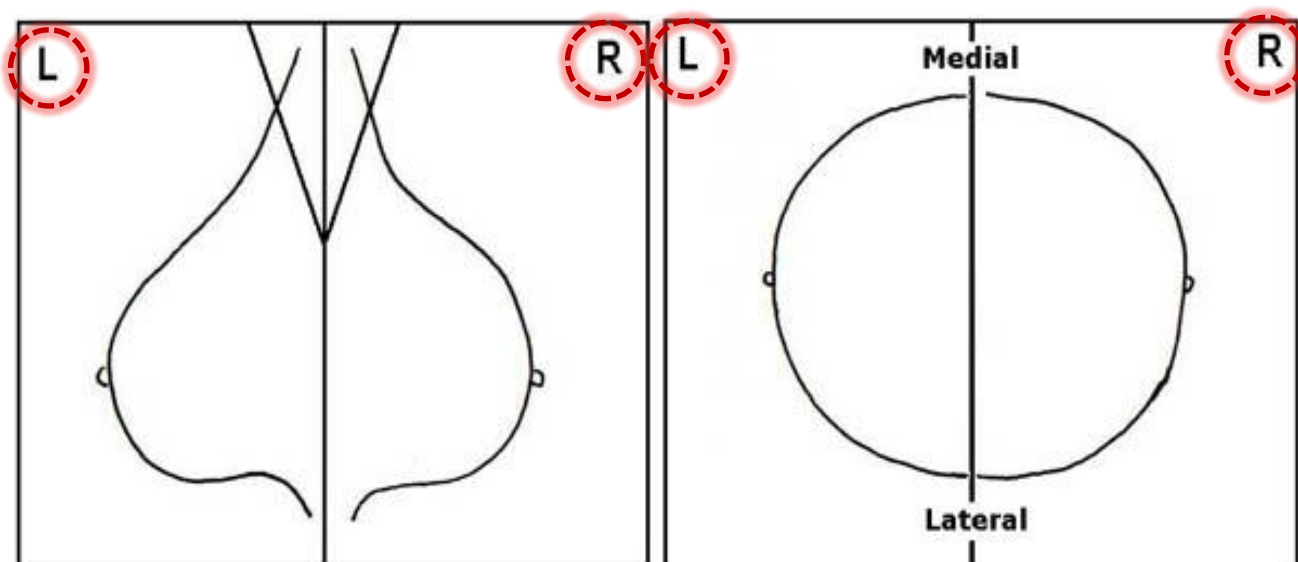
7 – Lymphscintigraphy

## Mammography: (takes 5-15 min)

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- \* X-ray examination of the breast is carried out with dedicated equipment designed to demonstrate soft tissues of the breast to advantage.
- \* A normal mammogram shows ductal and connective tissue in a background of fat.
- \* With increasing age, glandular tissue atrophies cancers become easier to identify.
- \* The mammographic appearances of the normal breast vary greatly from one patient to another.
- \* **In younger patients, it is best to start with ultrasound because they have more glandular tissue, which makes detecting abnormalities difficult.**
- \* **With older patients, start with mammography.**

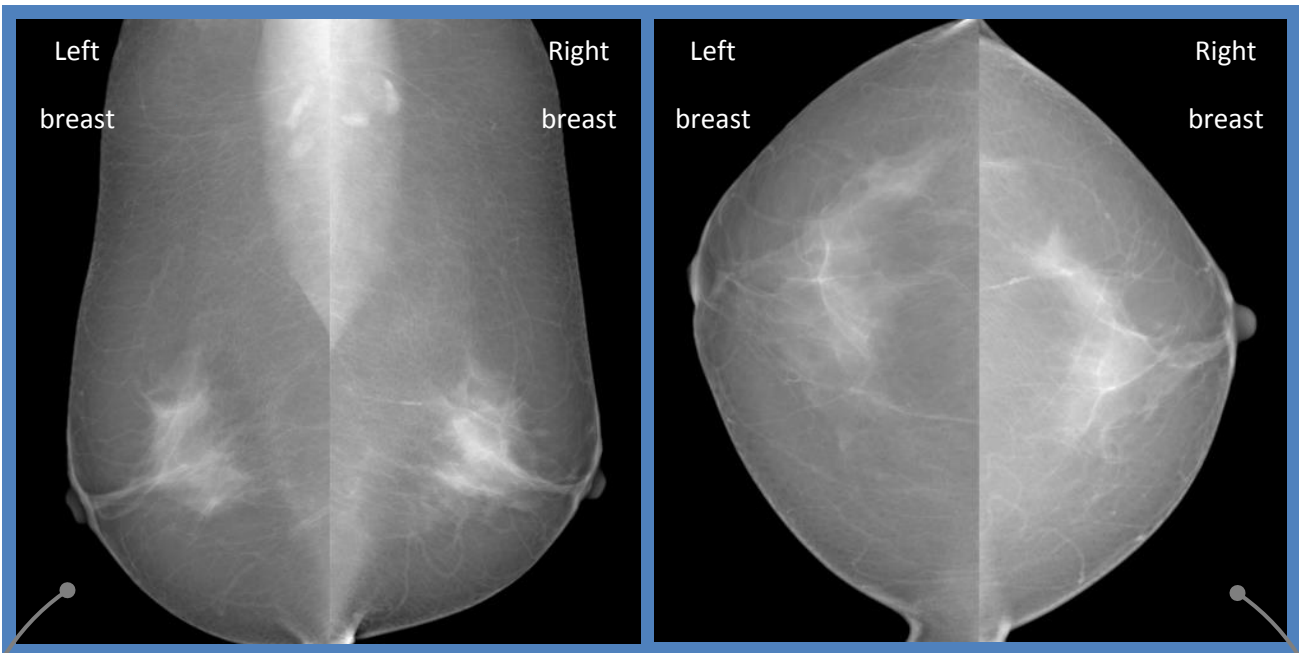
There are two types of viewing a mammogram: (explained more in the next page)



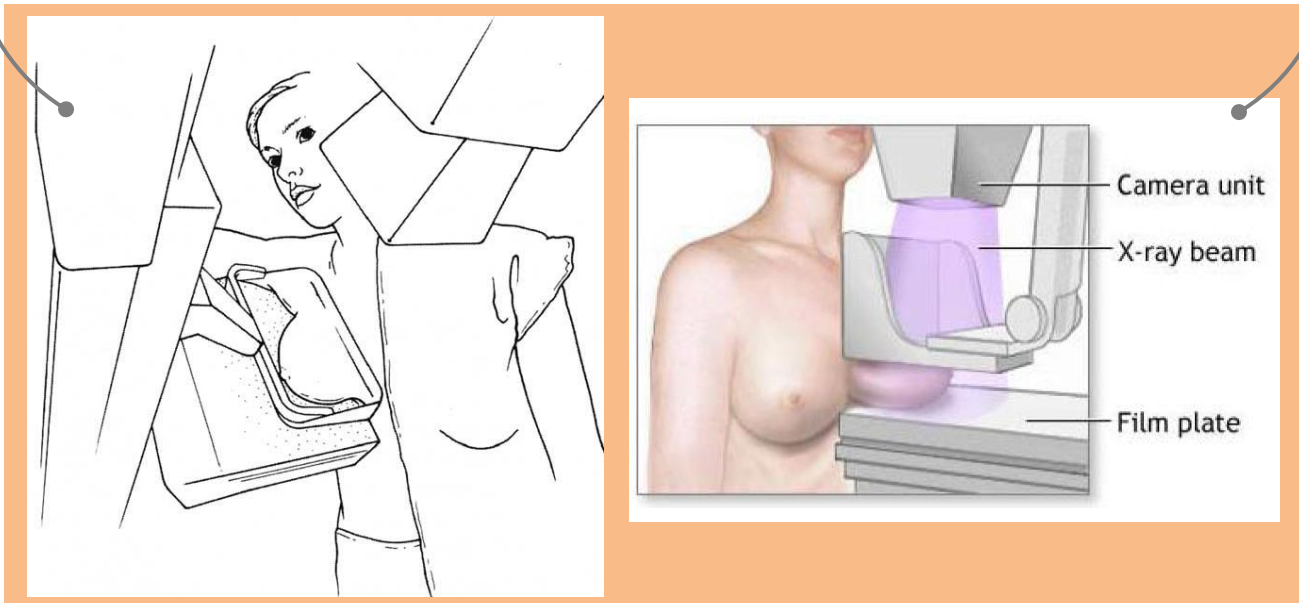
**MLO: Medio-lateral oblique**

**CC: Crano-caudal**

Real image:



*EXTRA: how to get these two views?*

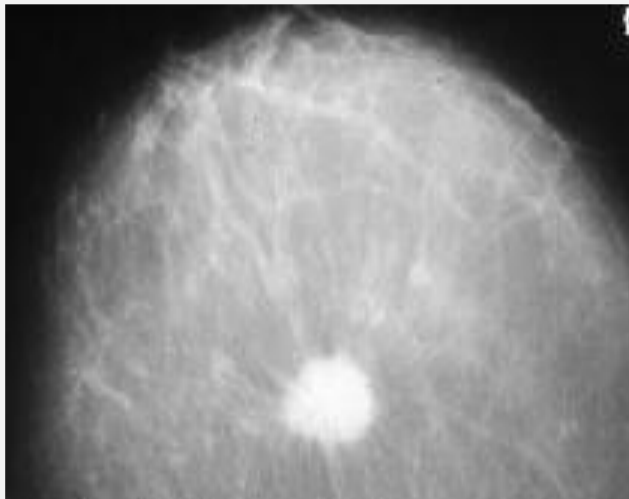
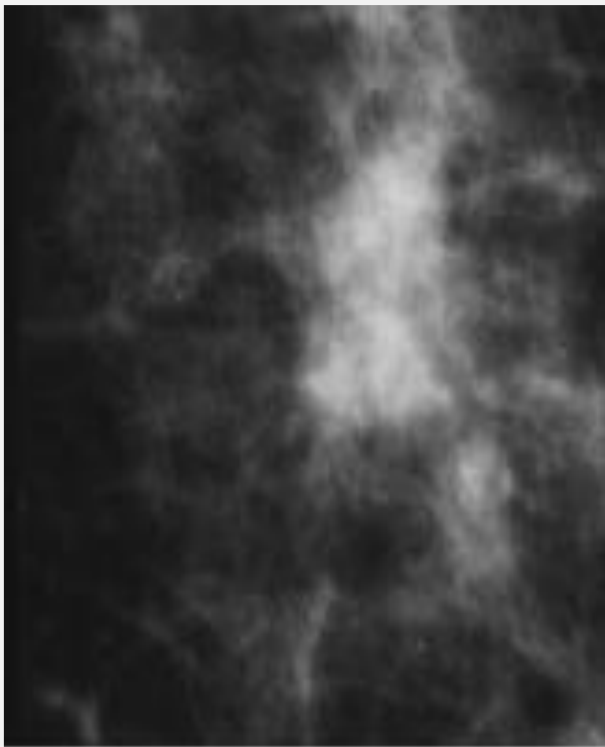


- We should use different views to cover as much tissue as we can and then compare different views.



## How to diagnose a breast lesion using mammography?

- Always **compare** between the two breasts looking for one of these abnormalities: *(you should know how to differentiate between them)*

| 1- Mass  | 2- Asymmetry   |
|--|--|
| <ul style="list-style-type: none"> <li>- Convex borders</li> <li>- Denser towards center</li> <li>- <b>Distorts related parenchyma (mass effect: displaces surrounding structures)</b></li> <li>- <b>Seen in multiple projections (3 dimensioned: detectable in two views)</b></li> <li>- Still seen in focal compression view</li> </ul>  | <ul style="list-style-type: none"> <li>- Ill-defined or irregular margins</li> <li>- Amorphous <b>(without a clearly defined shape)</b></li> <li>- Tissues spread over it.</li> <li>- No mass effect, not 3 dimensioned</li> </ul> <p><i>(it's simply anything you can't see in multiple images or anything which is not distorting the surroundings) it might be fat necrosis or skin lesion.</i></p>  |

- After ordering mammography, there are certain indications where you should go for **biopsy**:

When the **mass lesion is very suspicious** or when it's a **palpable mass**.

- Lactating patients have very dense breasts so mammography is useless in this condition

## Ultrasound (US)

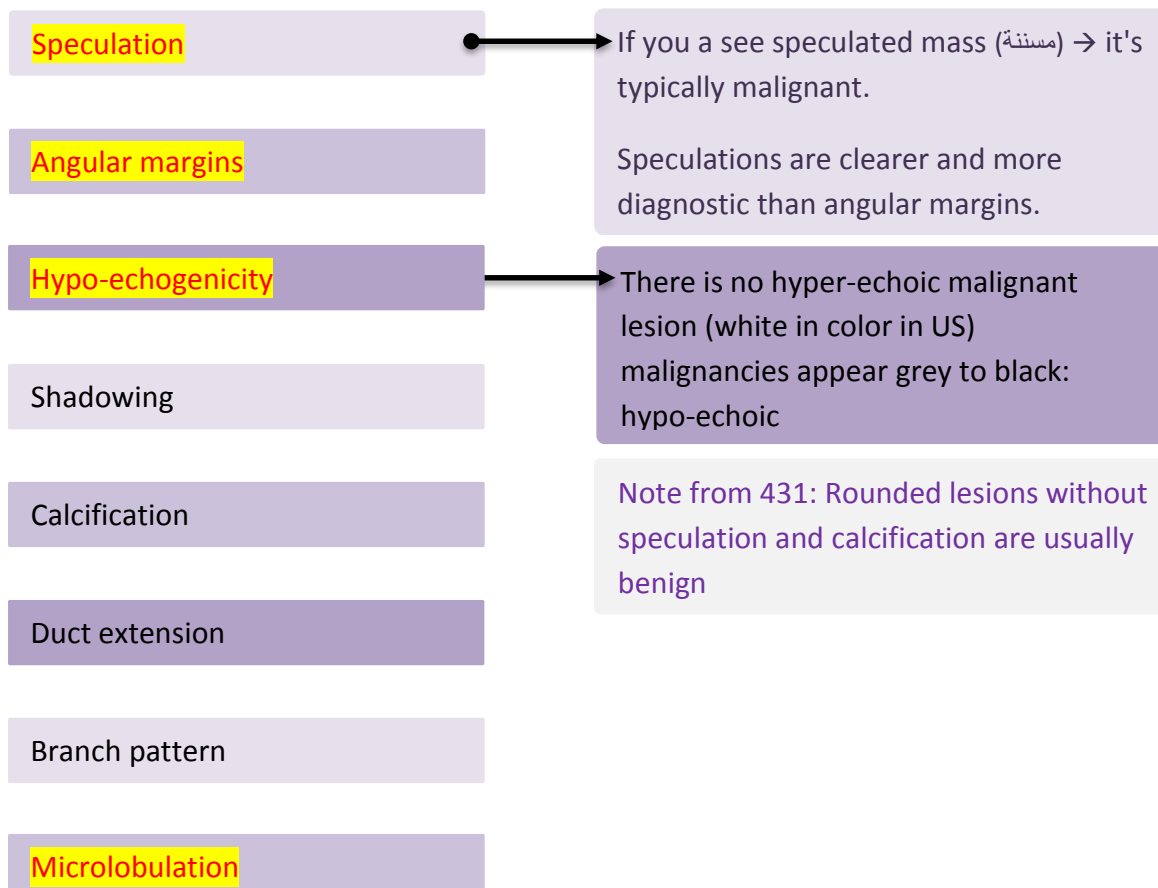
### 1 - Indications of using US: (Important)

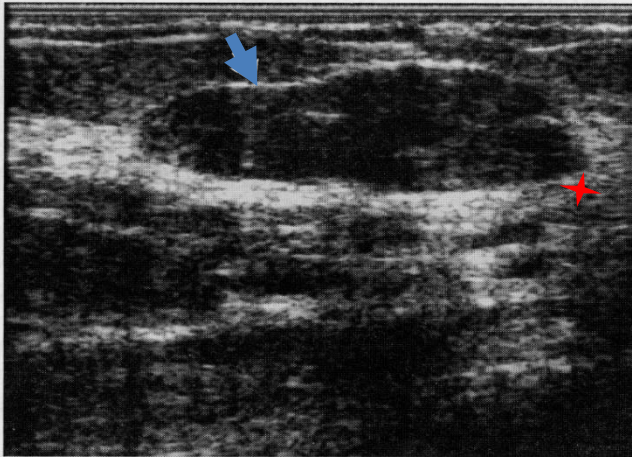
- Differentiation of both palpable and mammographic lesions as either **cystic or solid** (*characters of a mass lesion can be easily identified by US not by mammography: solid or cystic, benign or malignant*)
- Further characterization and classification of solid nodules according to certain sonographic features (*related to sound waves frequencies*)
- Evaluation of a palpable breast mass in a patient younger than age 30 (*US is the best modality for young patients, this point was explained in page 5*)
- Interventional procedures (BIOPSY) (*helps in localizing the mass for whoever going to take a biopsy*)

Special case: always use US for a pregnant patient. If there is any suspicion of presence of a mass → do biopsy.

### 2 - Identification of Malignant Features in ultrasound:

First, they identify the lesions with any of the following malignant features:



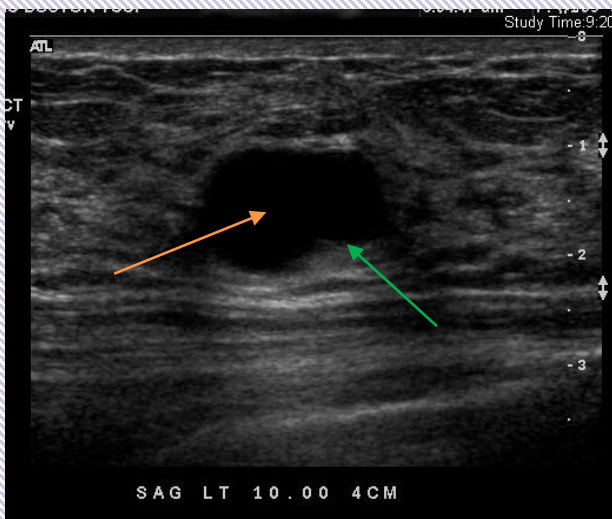


**Figure 3.** Fibroadenoma showing an echogenic pseudo-capsule (arrow).

Example of a benign fibroadenoma (most common benign solid tumors of the breast). Doctor commented: more common in young age. Looks very well defined, very far away from speculations with a regular capsule.

Red star: Ellipsoid shape (wider than tall)

Blue arrow: Thin echogenic capsule



Example of hypo-echoic well defined structure. (431: simple cyst on breast US)

Doctor commented: Smooth margins (not speculated: think of cyst), cystic enhancement (shadowing: cystic structure enhance sound beams → acoustic enhancement)

Difference between cyst and malignant mass: malignant mass is palpable in PE.

Green arrow: smooth margins

Orange arrow: anechoic

**MRI:** (takes 40-45 min)

High-field strength (1.0 – 1.5 Tesla) necessary, resulting in:

- a higher signal-to-noise-ratio
- shorter acquisition time
- better separation of fat and water peaks
- better contrast characteristics (T1 time increase)

Doctor skipped all this

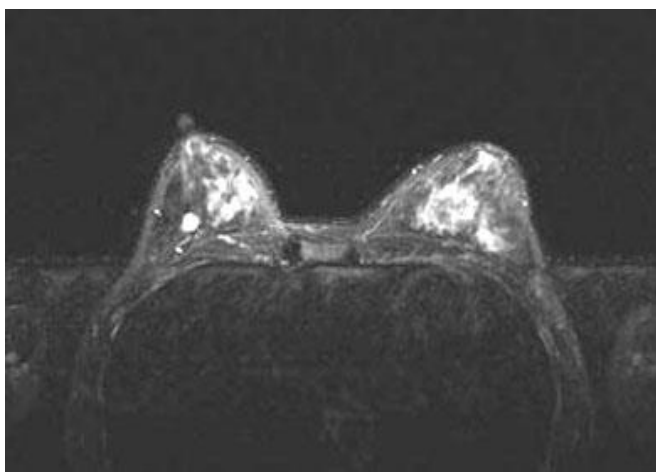


**Extra explanation by the doctor:**

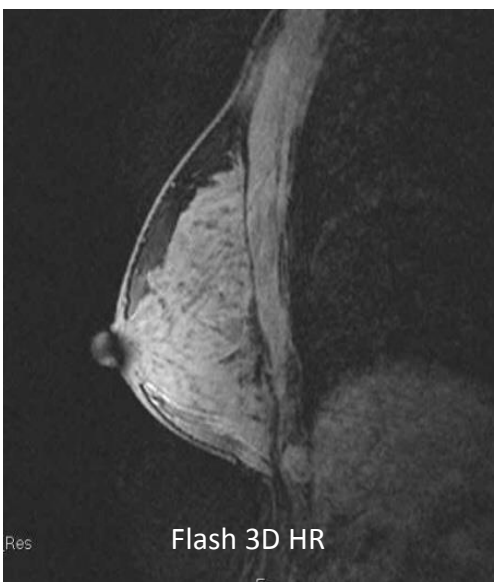
Breast tissue is rounded and full of fat, in mammography, we compress the breast to reduce thickness of the breast, and therefore, reducing the radiations. You reduce the possibility of the tissue superimposed of each other. The same rule here, we should compress the breast tissue. The patient lies down on her abdomen, she lies on the coil. Patient puts her breasts inside the openings and pressure is applied.

Compression bands: compress from side to side, breast tissue becomes compressed to spread the tissue as much as possible.

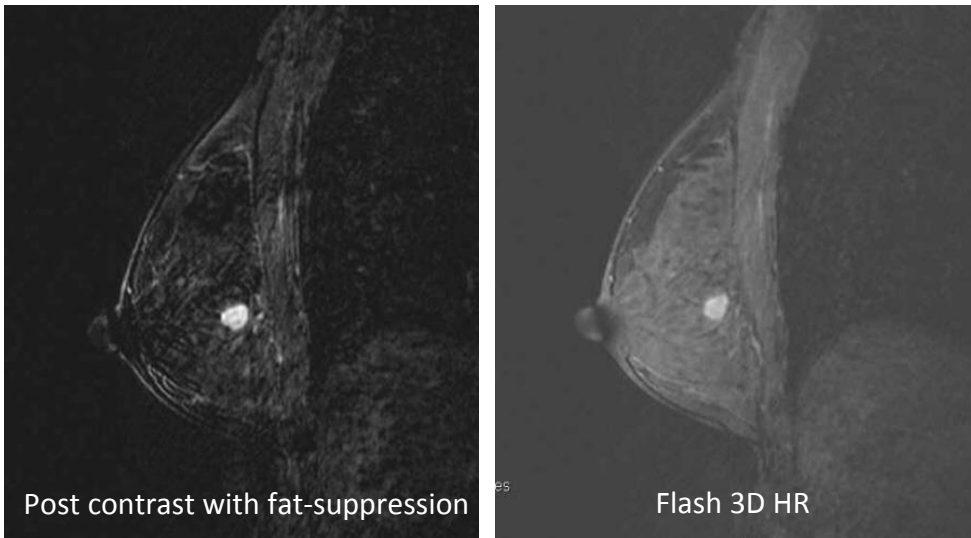
| Advantages of MRI   | Disadvantages of MRI  |
|---|---|
| two breasts together, multiple sequences (windows), you can order the machine to clear fat and you'll be able to see the breast tissue alone (breast parenchyma, mass lesion), Fat suppression (via contrast) | high cost, takes 45 min + IV contrast (u can't use it for pregnant, especially those in the 3rd trimester who can't lie on their abdomen) |



Static Imaging  
 STIR (Short tau inversion recovery)  
*The doctor discussed nothings in this picture*



Flash vibe, HR:  
 different sequences

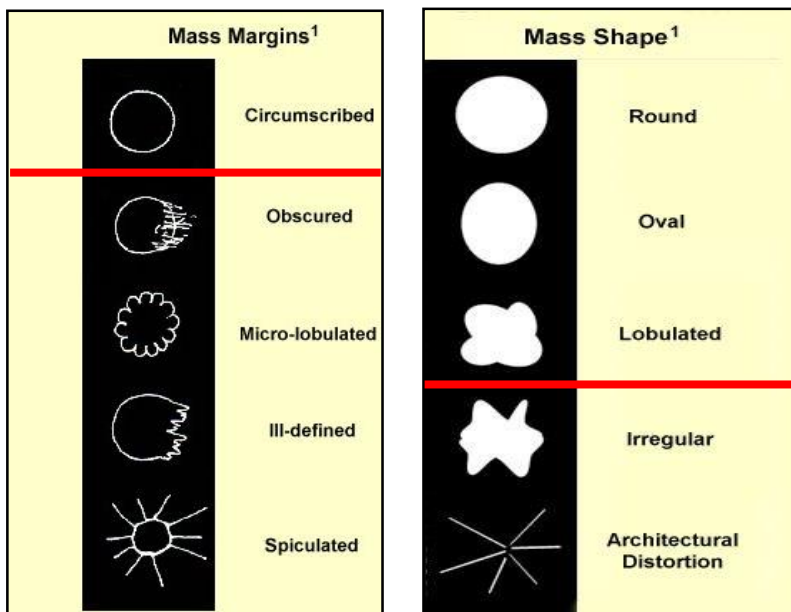


### d. Searching for malignancy

- 1- Characters of masses
- 2- Characters of calcifications

#### 1-Mass:

Characters of masses:



Margins are better in characterization of a mass lesion (more diagnostic)

Anything above the red lines can be benign or malignant; anything below is malignant.

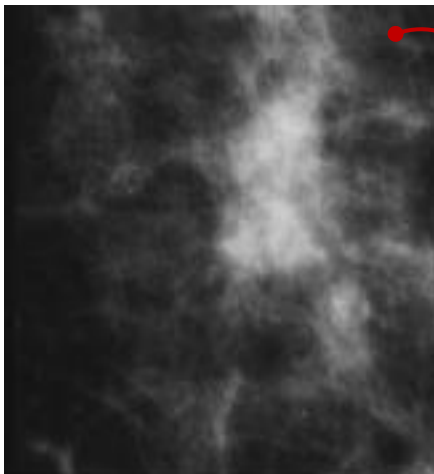
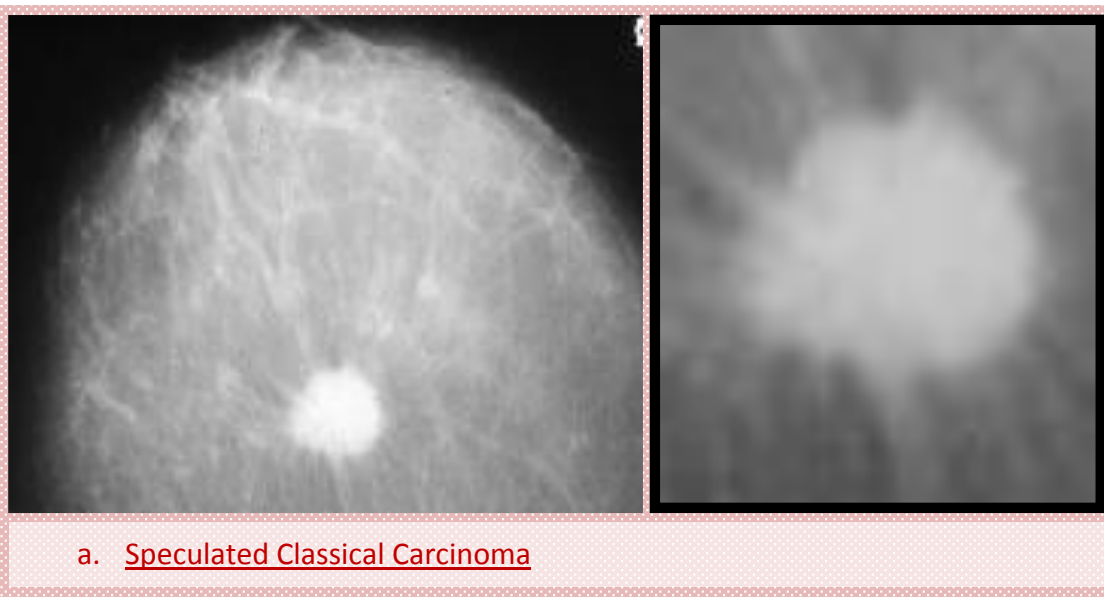
- Margins:

- Most important character

- If margins are obscured by breast tissues → *Compression /magnification views\*(next page)*

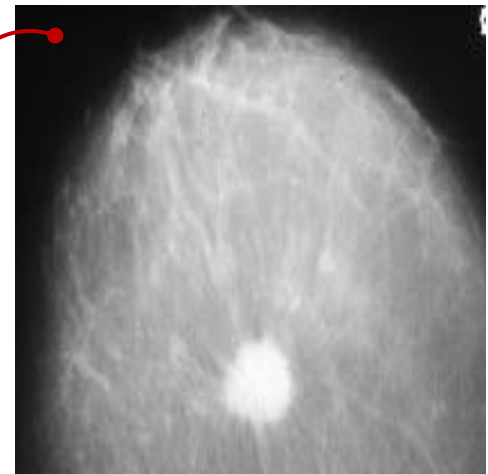
1- Speculated margins: more common in invasive, followed by tubular and then lobular

**Examples:**

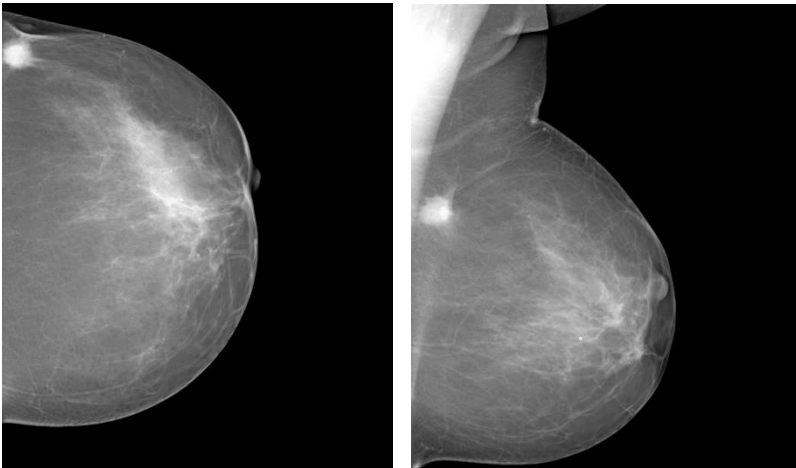


b. Speculated mass  
invasive ductal carcinoma

Skin dimpling is obvious  
with the speculated mass  
lesions (only in malignant  
lesions).

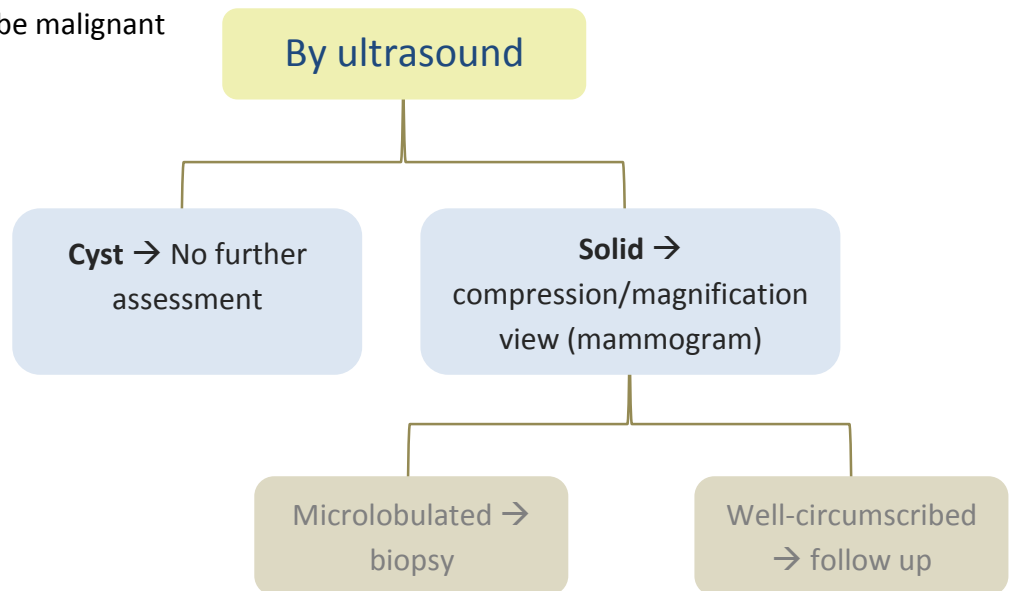


c. \*Compression /magnification views, you can see dimpling ↓



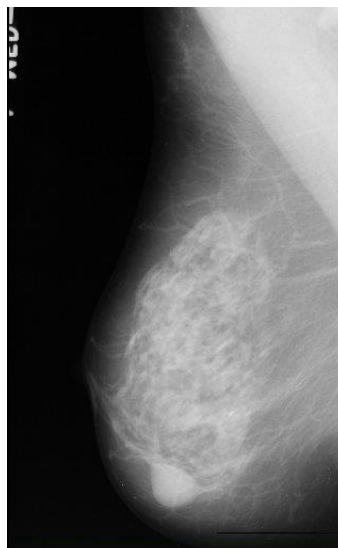
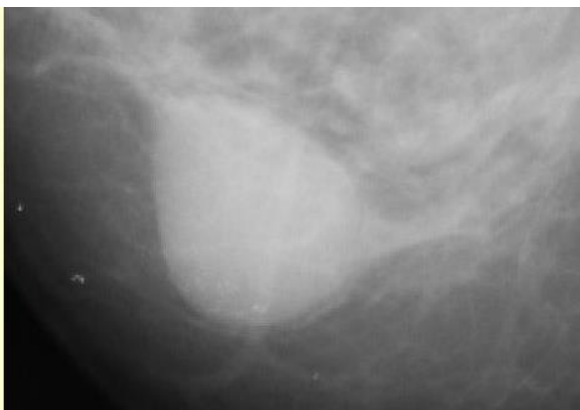
2- Well-circumscribed (well-defined) margins:

- Almost always benign
- 5% of them may be malignant

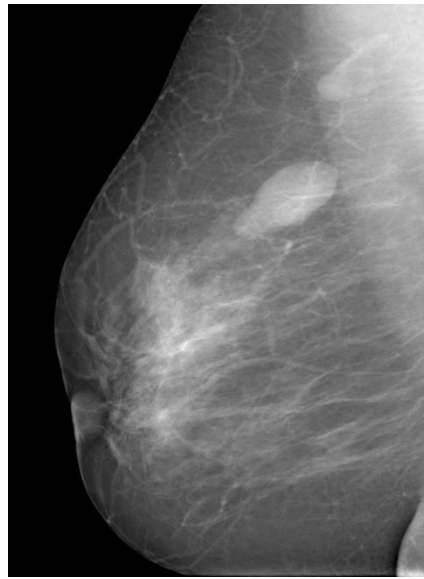


**Examples:**

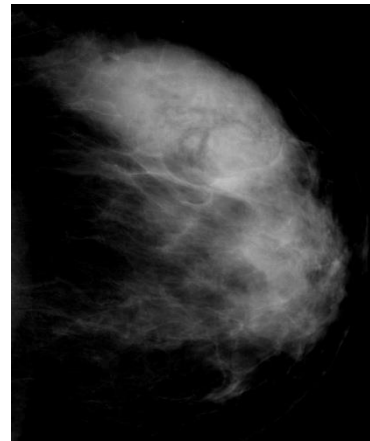
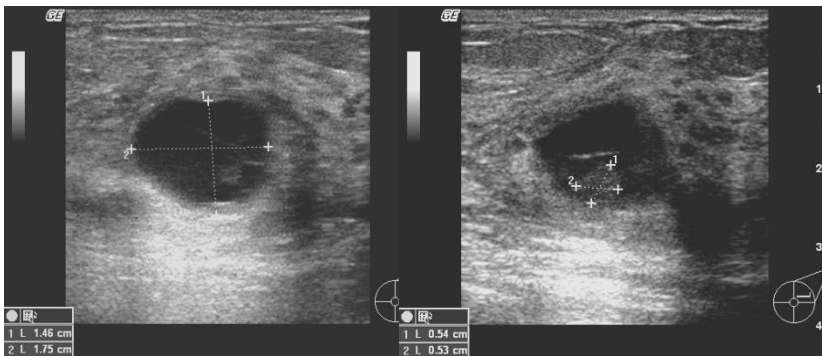
1 – Oval/Well circumscribed mass, it's benign (mediolateral view)



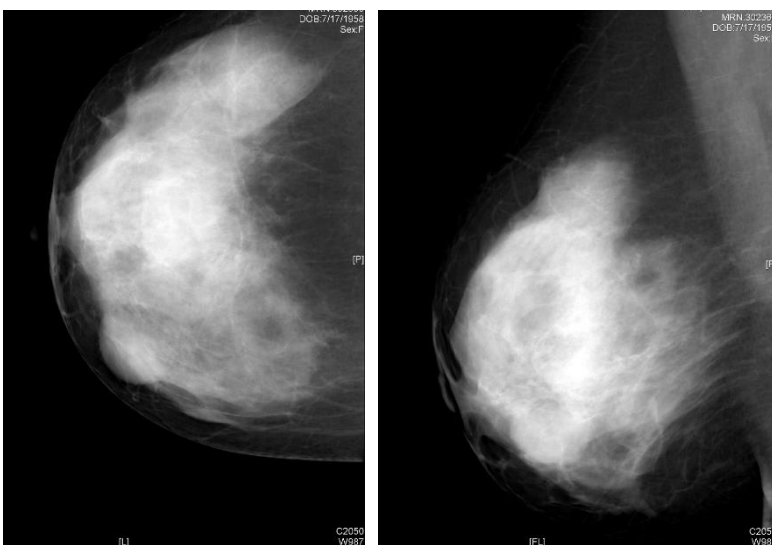
2 – Fibroadenoma, benign



3 – Hemorrhagic cyst in dense breast

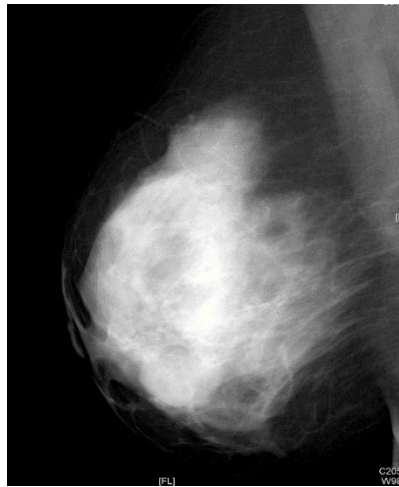
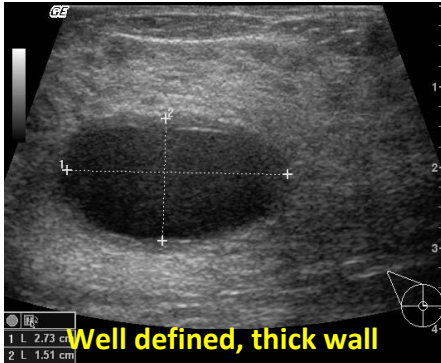


4 – Complicated cyst (mammogram)





5 – Complicated cyst  
(ultrasound ↓)



431: Complicated cysts have thick walls, dark fluid, and are well defined masses. May result in hemorrhage. We used mammography in the right pic, but it wasn't clear so we used US to see the lesion which is not speculated and well defined thick walls and it is Benign.

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### The density categories used: (not imp)

- \* High density: clearly higher than surrounding, suspicious.
- \* Equal density: density not appreciably different, neutral significance.
- \* Low density: density lower, but not fat containing, neutral significance.

## - Number of masses

### Facts:

- Multiple well-defined masses are probably benign.
- Multiple primary malignant lesions are obviously ill-defined or stellate lesions.
- Benign and malignant lesions can coexist

## 2- Calcifications:

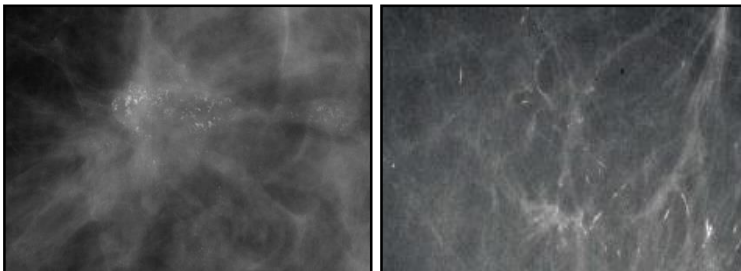
### Size

- Micro calcifications are associated with a malignant process, 0.5 mm or less → high probability of association with cancer.
- Macro calcifications are associated with a benign process, 2.0 mm or larger are typical of a benign process.
- The smallest visible calcifications on a mammogram is approximately 0.2 - 0.3 mm.

### Morphology

- Most important indicator in differentiating benign from malignant.
- Round and oval shaped calcifications that are also uniform in shape and size are likely benign.
- Irregular in shape and size calcifications fall closer to the malignant end of the spectrum.
- It has been described that calcifications associated with a malignant process resemble small fragments of a broken glass and are rarely round or smooth.
- ACR BIRADS Classification  
The American College of Radiology (ACR) Breast Imaging Reporting and Data System (BIRADS) has classified findings of calcifications into three categories:
  - (1) Typically benign
  - (2) Intermediate concern
  - (3) Higher probability of malignancy

### Malignant micro calcification:



- Calcification without a mass: might be a very early malignancy, better to detect early.

- CLUSTERED : > 5 in 1cm<sup>2</sup>
- Branching interrupted ill-defined ductal

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Scattered calcification: benign

Clustered calcification: malignant (important sign of malignancy)

**Extra note from 431:**

- \* Hyperechogenic: non-malignant mass
- \* Hypoechoic: could be mal. Or non-mal.
- \* Anechoic: cyst (Complete black hollow)
- \* Hypoechoic: solid mas (few small hyperechogenic structures)

**SUMMARY**

1. Anatomy of the breast:
  - Terminal interlobular duct is the part that give rise to 95% of breast cancers
2. Stages of breast cancer:
  - In situ (DCIS): not invading basement membrane, diagnosing at this stage → better prognosis
  - Invasive (IDC): invading basement membrane, considered as a late stage
3. Diagnostic tests:
  - Mammography: two views; MLO & CC, it's usually the first option for old patients
  - Ultrasound: first option for pregnant, lactating or/and young patients
    - Indications: doubting cystic or solid, types of solid nodules, guiding a biopsy
    - Features of malignancies: speculations, angular margins, hypoechoicity, midcrolobulations
  - MRI
4. Searching for malignancies:

| Mass   | Calcifications   |
|--|--|
| Look for margins: speculated or well-defined | Look for size: micro calcification or macro calcifications |

## Questions (from 431♡)

1/ A 57-year-old woman comes for an annual visit with no breast complaints. Which of the following imaging studies is an appropriate screening study?

- (a) ultrasound examination of both breasts
- (b) magnetic resonance imaging of both breasts
- (c) screening mammography of both breasts
- (d) breast screening is not appropriate for a patient of this age

2/ a 40-year-old woman came to the clinic with a family history of breast cancer for breast screening. Which of the following is the best modality for imaging?

- (a) ultrasound examination of both breasts
- (b) magnetic resonance imaging of both breasts
- (c) screening mammography of both breasts
- (d) breast screening is not appropriate for a patient of this age

3/ In characterizing a suspicious mass lesion for malignancy by imaging which of the following is the most important?

- (a) Shape
- (b) Margin
- (c) Size
- (d) None of the above

Answers:

- 1) C
- 2) B
- 3) B



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