



Radiology
Team 438

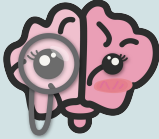
Radiology of breast diseases

Lecture 21

Objectives

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

Reviewed By



Noura Alturki
Jehad Alorainy

Color Index:

♦ Important

♦ Doctor's Notes

♦ Extra

♦ Female slides

♦ male slides

Team Leaders



Omar Aldosari



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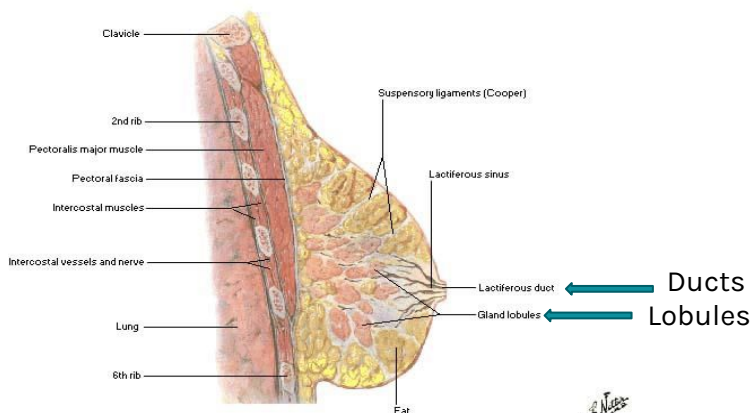
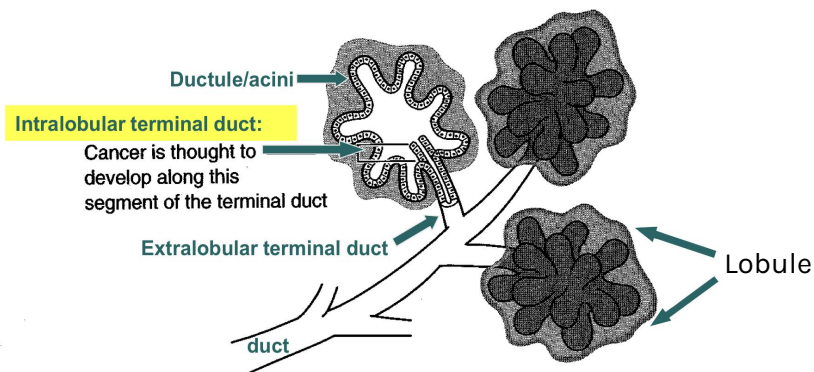
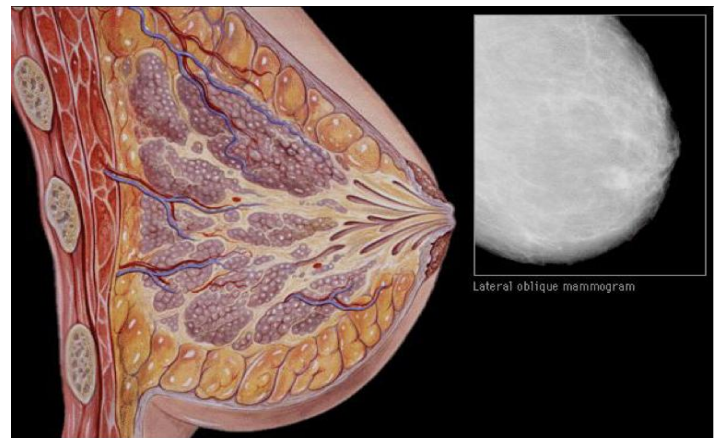
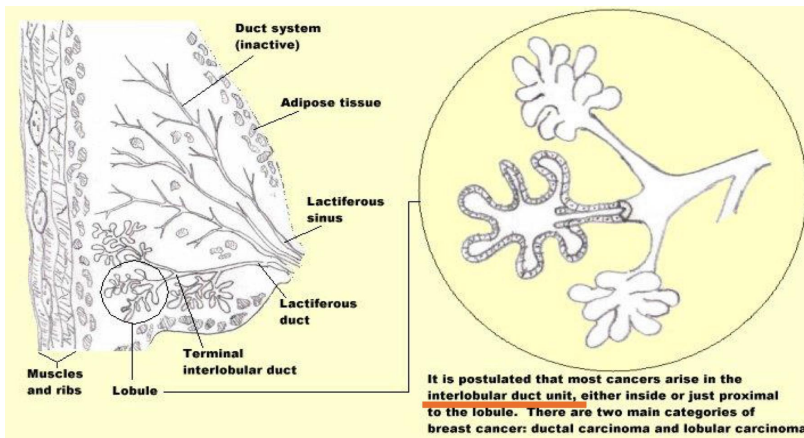
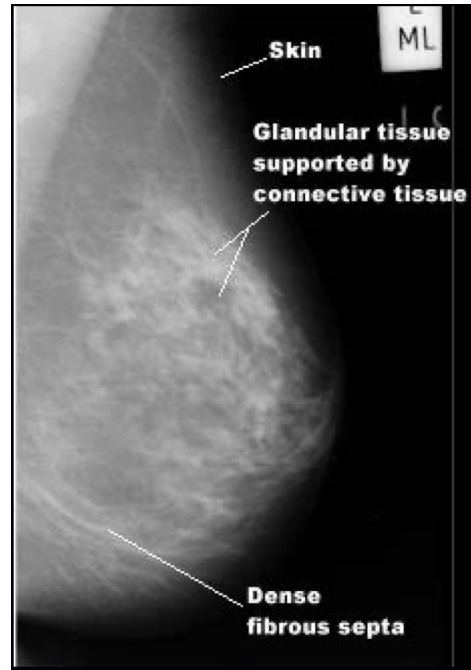
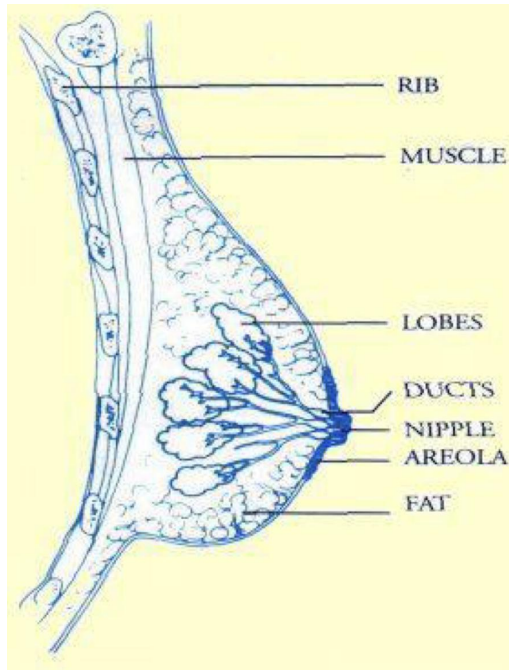
Shahd Alsalamh

Done by:

Arwa Alemam

Sarah Alarifi

Basic Anatomy


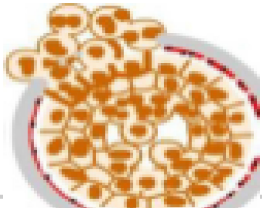


Most breast cancer develops in the terminal ductal lobular unit (TDLU)
 Terminal ductal lobular unit is composed of:
 1- intralobular terminal ducts.
 2- Acini

The epithelium inside the lobules is histologically distinct from the epithelium in the extralobular ducts .

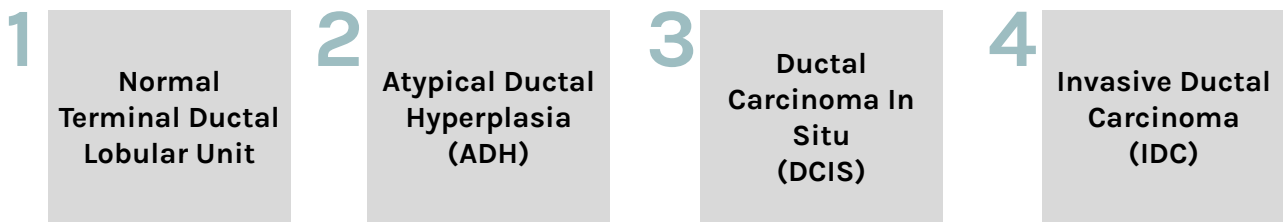
Breast Cancer

» Breast Cancer can be divided into two major groups :

In situ	Invasive
<ul style="list-style-type: none"> • Tumor cells have not invaded the basement membrane . • Tumor cells remain confined to the ducts or lobules . <p>DCIS The membrane here is intact</p> 	<ul style="list-style-type: none"> • Tumor cells invade the breast stroma . • They have the potential to metastasize and result in death of the patient . <p>Invasive ductal carcinoma The membrane here is invaded</p> 

» Ductal cancer evolves over time :

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

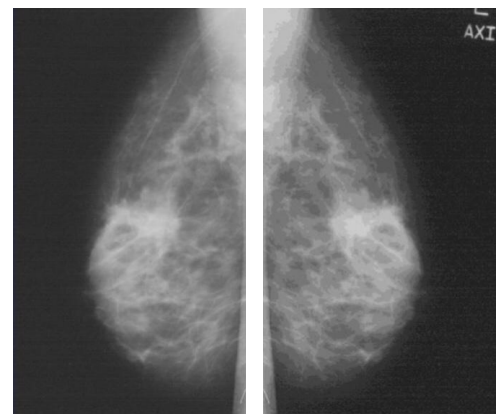


» The Four Pillars of Diagnosis :

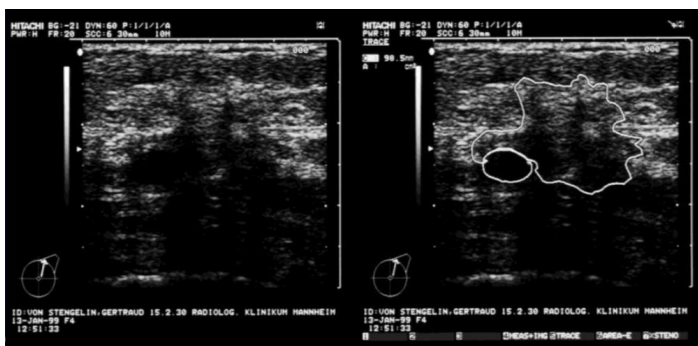
Clinical or Self Examination (PE)



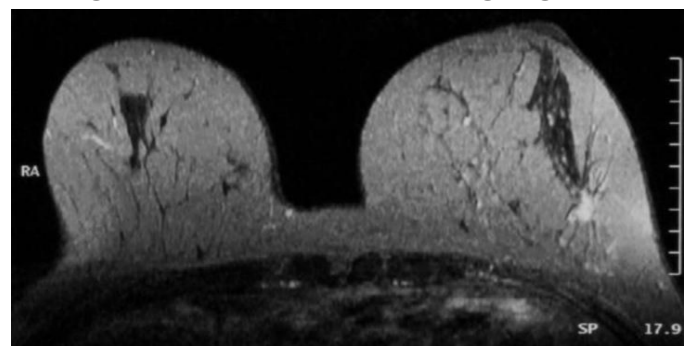
Mammography (MG)



Ultrasound (US)



Magnetic Resonance Imaging (MRI)



Breast Tests

➤ Breast Tests :

1

Mammography

Can rule IN cancer, but **can not rule it OUT**.

2

Ultrasound

3

CT scan

(with and without contrast)
Not for breast lesions but for staging.

4

MRI

(with and without Gd contrast)

5

Ultrasound or MRI guided biopsy and wire

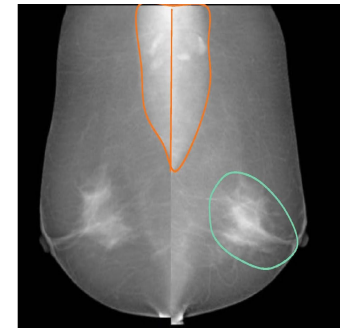
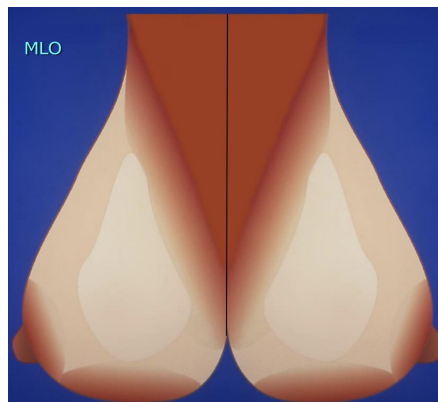
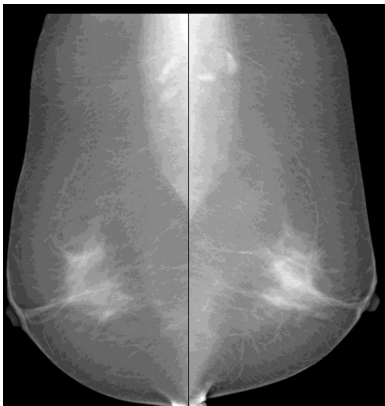
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Bone radionuclide scan

7

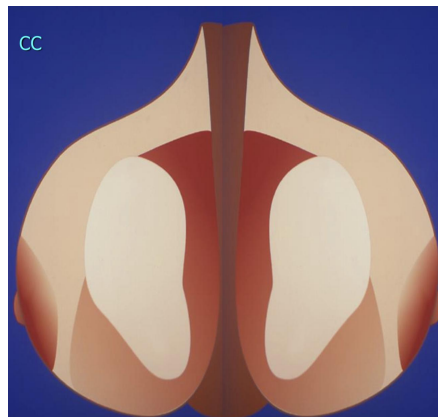
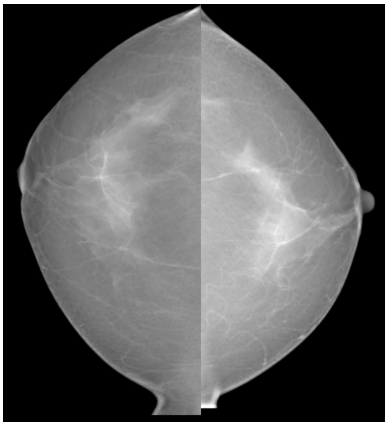
Lymphoscintigraphy

➤ Views :



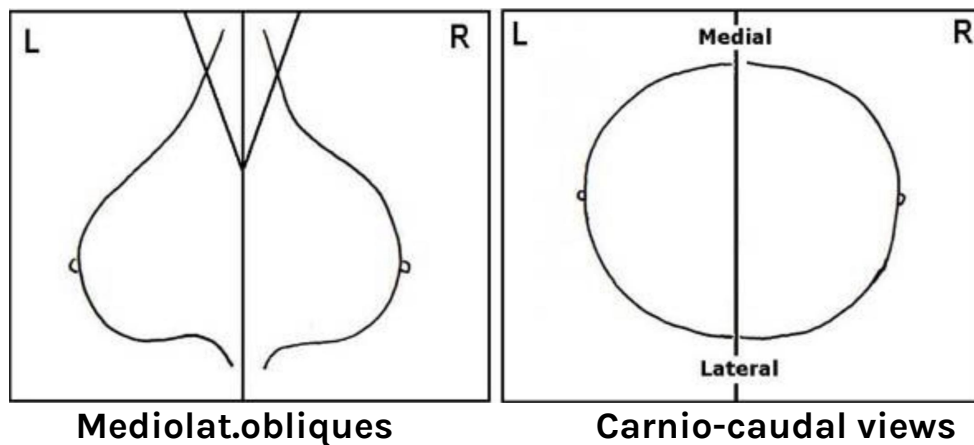
- Pectoralis muscle and axillary lymph nodes.
- fibroglandular tissue.

MLO



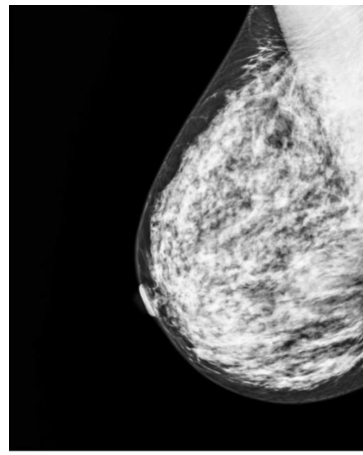
CC

➤ Viewing method :



» Dense breasts :

- ❖ Needs :
 - 1- Extra images
 - 2- Extra modality

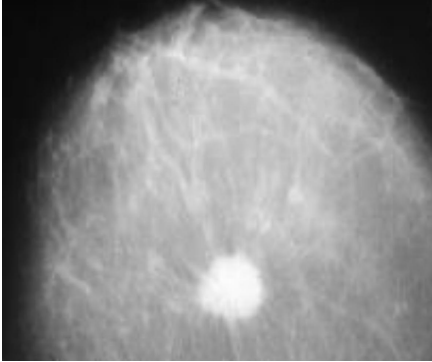
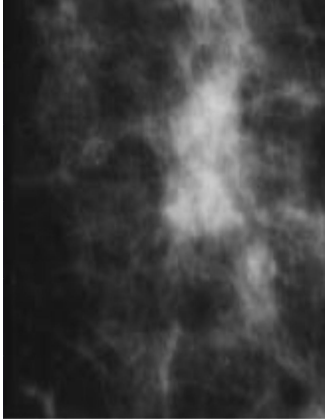


Dense Breast

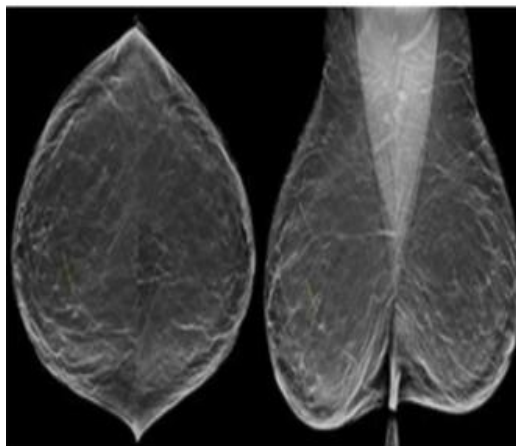


Fat-Replaced Breast

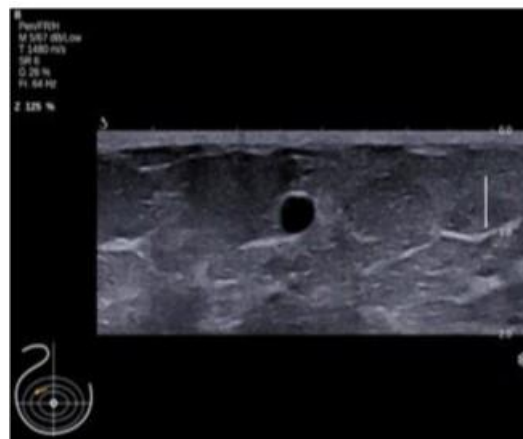
» FIRST Decide if there is a mass (compare both breasts) :

Mass	Asymmetrical Density
<ul style="list-style-type: none"> ● Convex borders ● Denser towards center ● Distorts related parenchyma ● Seen in multiple projections ● Still seen in focal compression view 	<ul style="list-style-type: none"> ● ill defined or irregular ● Amorphous ● Tissues spread over it 

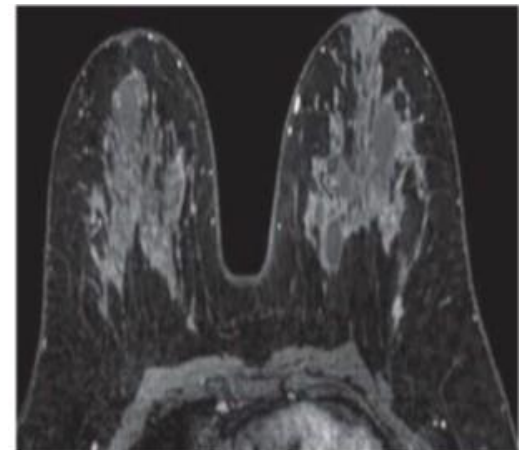
❖ If mass is palpable at the site of focal asymmetry → **Biopsy!**



Mammogram



Ultrasound



MRI

Modality and age

<30	Ultrasound
30-39	No complain → US Complain → MG then US
>=40	Mammogram : - If +ve Do US - If -ve you are DONE

❖ US is preferred because:

- * Low radiation.
- * Glandular tissue is more than the adipose tissue .
- ❖ Always start with mammogram in women above 40 year old .
- ❖ Mammography should be avoided in females age less than 30 as much as possible because of radiation .

Mammogram

Screening (No complain) :

- ❖ Patients 40 year old and above, it is not necessary to have a history of breast cancer.
- ❖ Young patient with **first degree relative (Mother/ Sister) diagnosed with breast cancer due to genetic mutations in BRCA1 & BRCA2** we start the screening 10 years before the first relative was diagnosed but remember we don't start screening before the age of 25!. Another situations includes one of these syndromes : **Cowden syndrome** (multiple hamartoma syndrome) or **Li-Fraumeni syndrome** , **and if the patient has a history of chest exposure to radiation in her childhood .**

Mammogram indications

Diagnostic (Complain) :

- ❖ Palpable mass .
- ❖ **Nipple discharge .**
- ❖ Skin changes .

Ultrasound :

Indications :

- ❖ Differentiation of both palpable and mammographic lesions as either **cystic or solid .**
- ❖ Subsequent characterization and classification of solid nodules according to certain sonographic features .
- ❖ Evaluation of palpable breast mass in patient younger than age 30 (**very dense breast**) and lactating and pregnant women . .
- ❖ Interventional procedures (**BIOPSY**) .

➤ Ultrasound cont :

➤ Identification of Malignant Features :

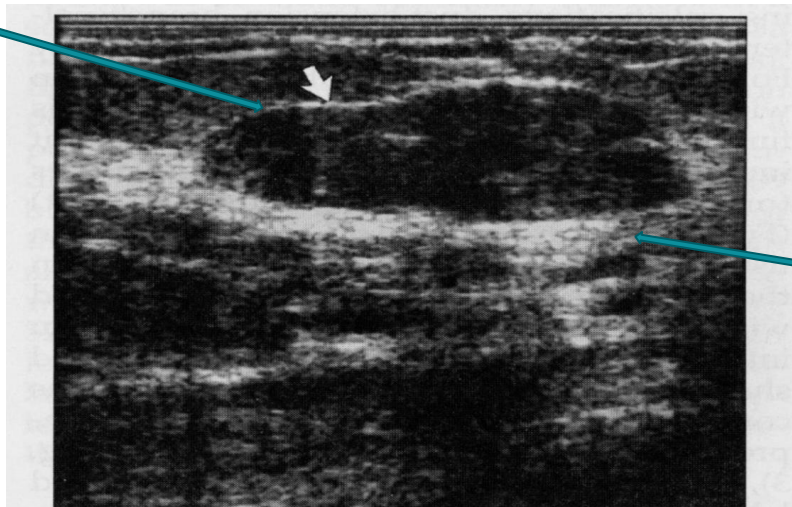
First , they identified lesions with any of the following malignant features :

- ❖ Spiculation
- ❖ **Angular margins**
- ❖ **Hypoechoogenicity**
- ❖ Shadowing
- ❖ Calcification
- ❖ Duct extension
- ❖ Branch pattern
- ❖ **Microlobulation**

➤ Example of benign fibroadenoma on ultrasound :

Thin echogenic capsule

Most common
benign solid
mass of the
breast

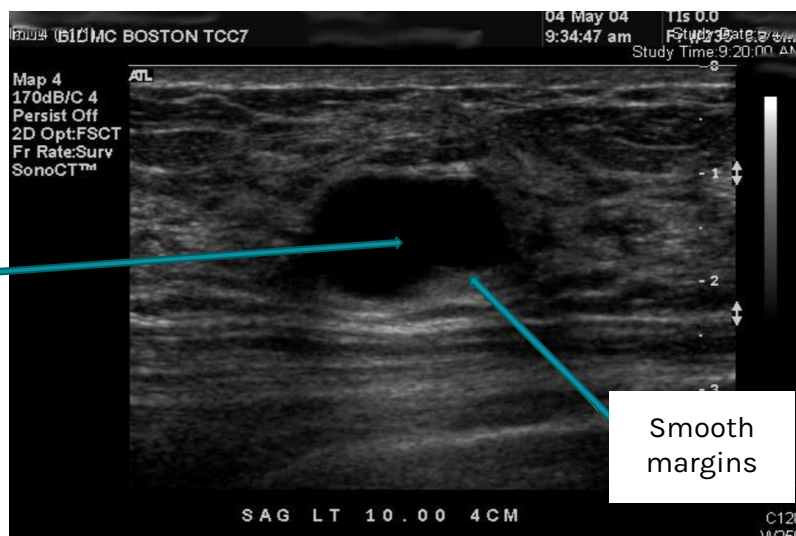


Ellipsoid shape
(wider than tall)

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

➤ Example of simple cyst on breast ultrasound :

Anechoic Jet black



Smooth
margins

➤ MRI :

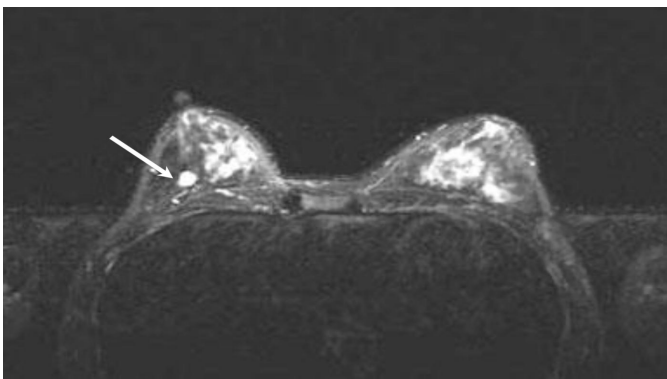
- ❖ High-field strength (1.0 - 1.5 Tesla) necessary , resulting in :
 - a higher signal-to-noise-ratio
 - shorter acquisition time
 - better separation of fat and water peaks
 - better contrast characteristics (T1 time increase)
- **Prone positioning** (the best position to perform breast MRI) .

❖ Indications:

- **Staging**, adherence to nipple, surrounding parenchyma. Extension of the disease
- **High risk patients**, family Hx (mothers or sisters)BRCA1 and BRCA2.
- Monitoring response to therapy.
- Post operative to differentiate surgical scar versus recurrence.
- Occult breast cancer.
- Assess the contralateral breast.
- Breast implant (**Silicon**) patient with breast implant complains we do MRI .

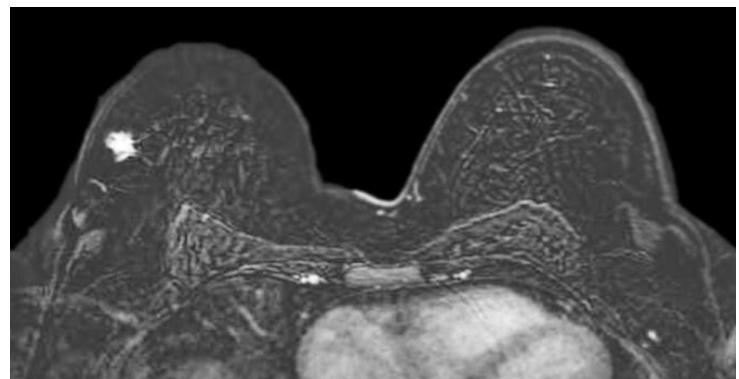
❖ Contraindicated in :

- Claustrophobia
- Cardiac pacemaker or any metal prosthesis

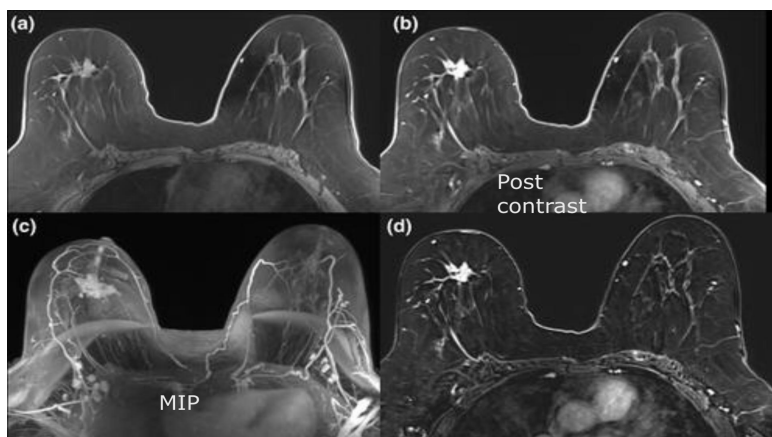


Static Imaging

STIR (Short tau inversion recovery)



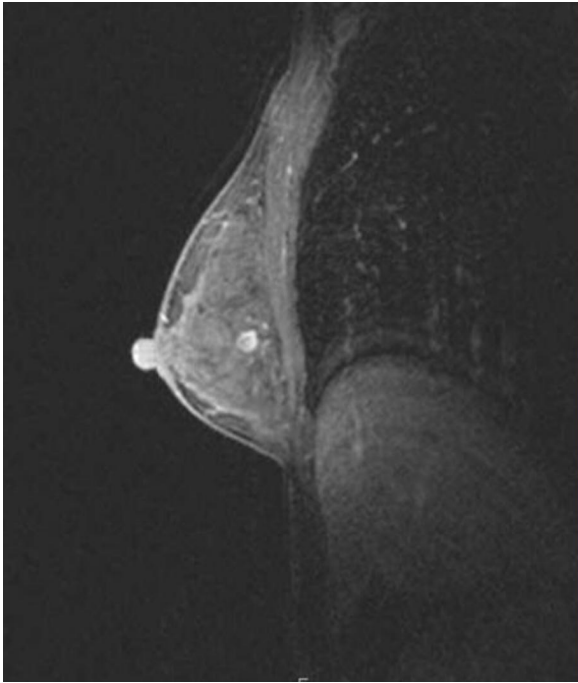
Subtraction images in MRI



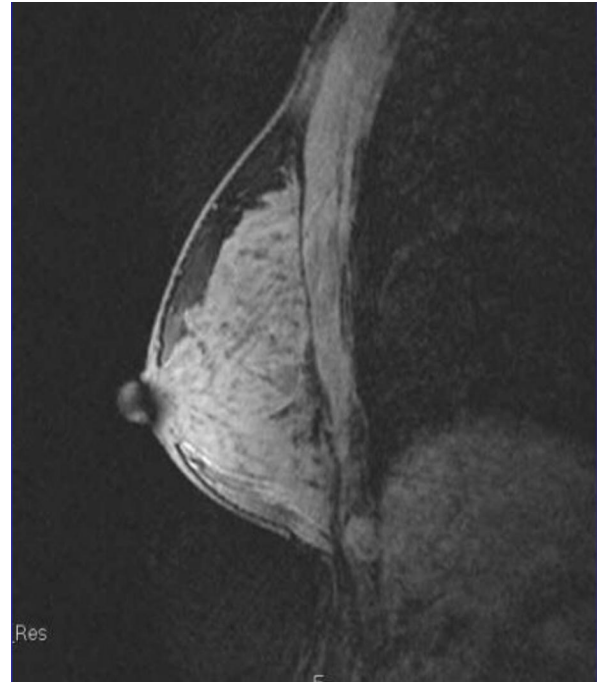
Different phases and post processing

» MRI Cont :

» High resolution Imaging :

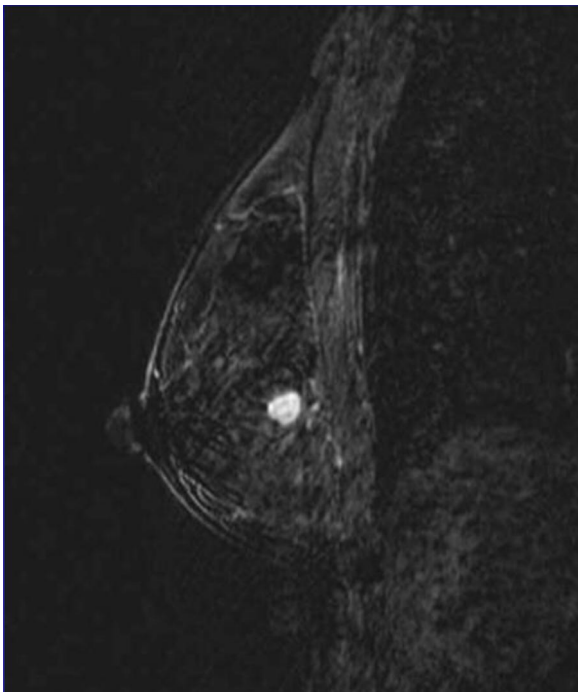


Flash 3D Vibe

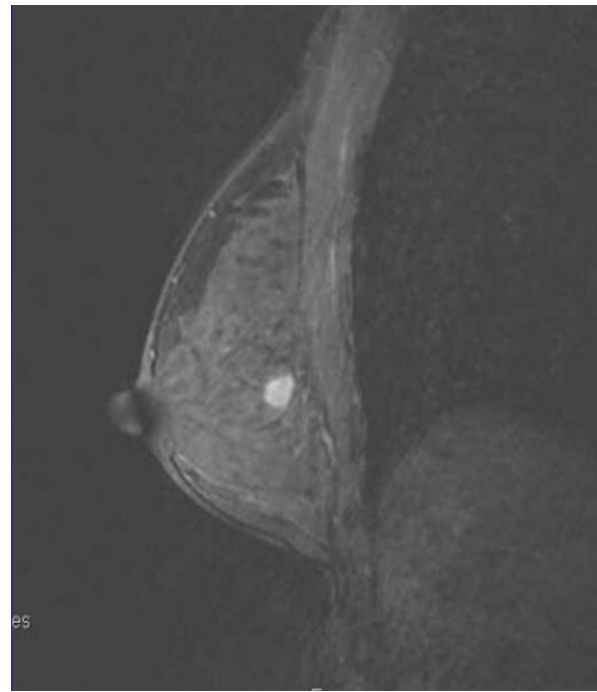


Flash 3D HR

» Dynamic Imaging :



Post contrast with
fat-suppression



Flash 3D HR

Breast malignancy

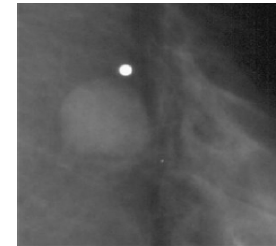
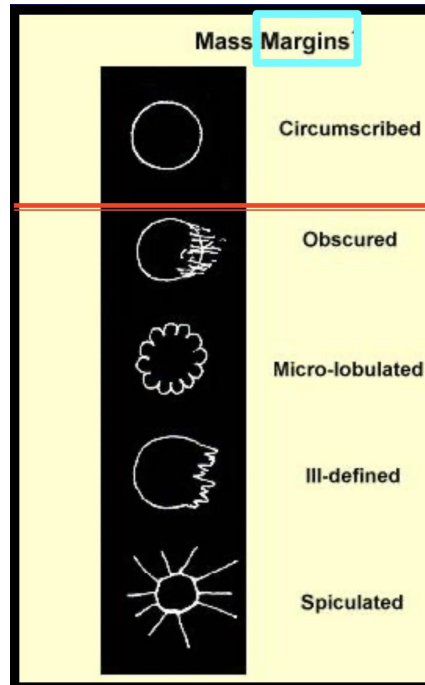
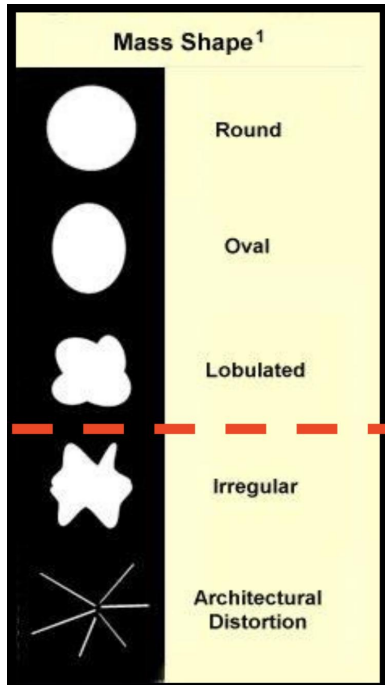
1- Mass

In the search of malignancy

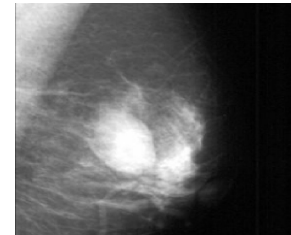
2- Calcifications

» Mass :

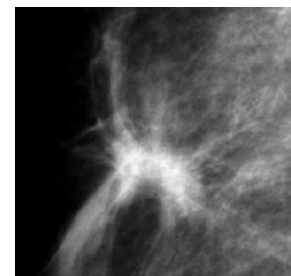
Characters of masses



Rounded



Oval



Irregular
(suspicious)
more with aggressive mass

Margins

❖ Most important character .

❖ If margins are obscured by breast tissues → Compression / magnification views

What's the most important character to differentiate between benign and malignant? Margins

Spiculated margins

❖ Classical carcinoma

❖ More common in :

invasive > tubular > lobular

❖ DDX :

- Fat necrosis (previous surgical biopsy)
- Scars (previous surgery)
- Radio-opaque mark
- Previous scar
- Any increase in size → biopsy
- Radial scar (complex sclerosing lesions)

Well circumscribed (well-defined) margins

❖ Almost always benign .

❖ 5% of them may be malignant .

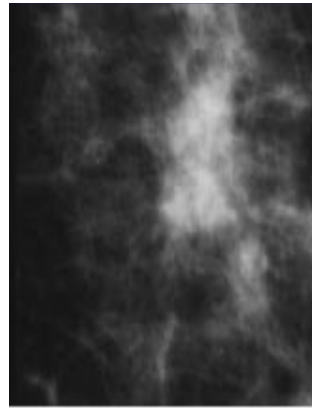
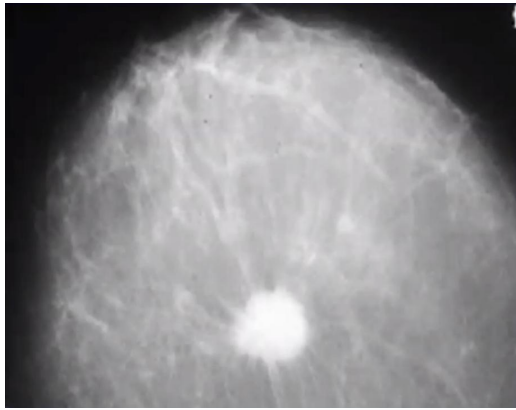
❖ ultrasound :

Cyst → No further assessment .

Solid → Compression / magnification views :

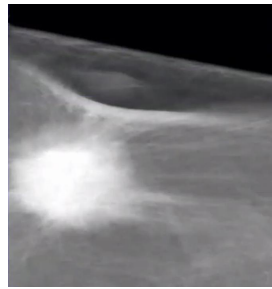
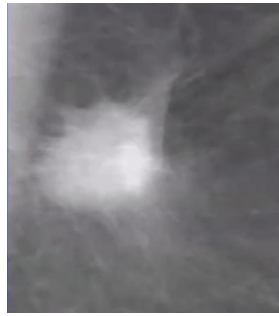
- Microlobulated → Biopsy
- Well Circumscribed → F/U

Spiculated margins



Spiculated mass
invasive ductal carcinoma

» Spiculated Margins



Spiculated Margins:

DD:


FAT necrosis (previous surgical biopsy) SCARS (previous surgery)

- ◆ Radio-opaque mark
- ◆ Previous scar
- ◆ Any increase in size----> biopsy

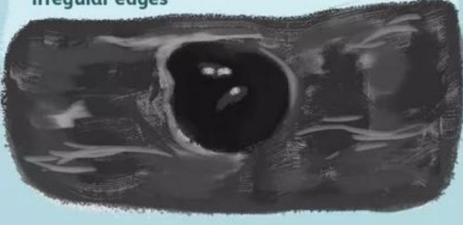
RADIAL SCAR (complex sclerosing lesions)

Identifying Breast Cancer

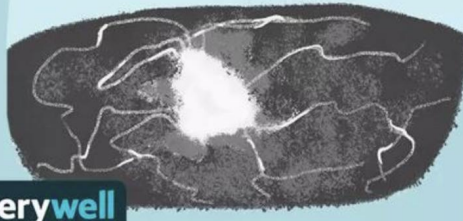
Mammogram: Cancerous mass may appear as a bright and irregular image with spiky or fuzzy edges



Ultrasound: Cancerous mass appears darker, indicating it's solid. It may also have spiky or irregular edges

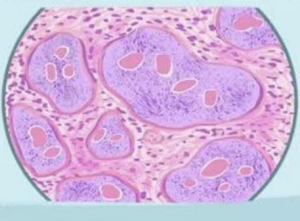


MRI: Contrast agent causes cancerous mass - or outside of mass - to brighten, then fade. Irregular or spiky borders are common



Biopsy: Under microscope, cancer cells may:

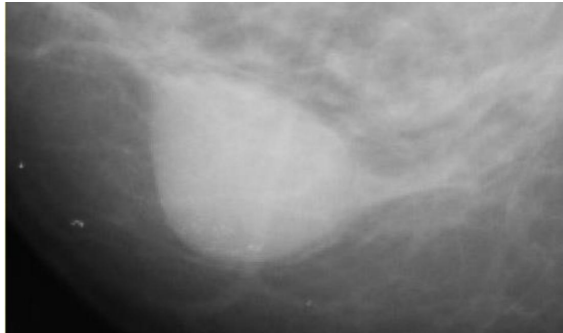
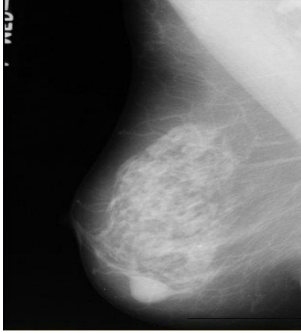
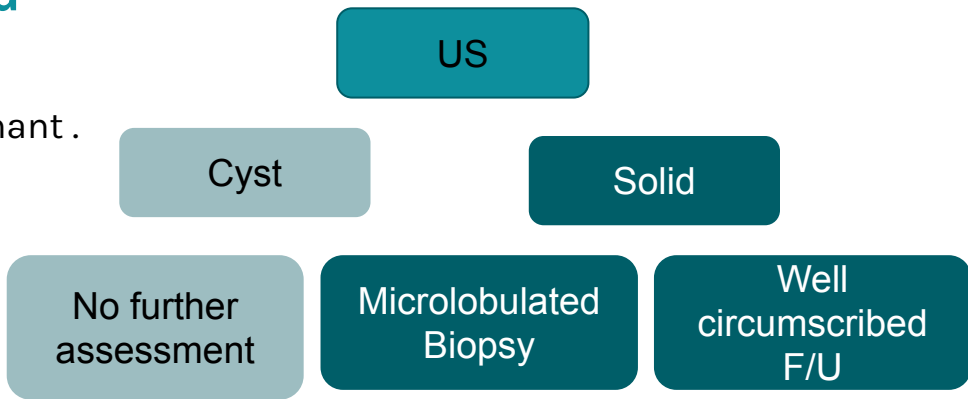
- appear clustered
- have irregular, large, or additional nuclei
- be invading blood vessels or lymphatic vessels



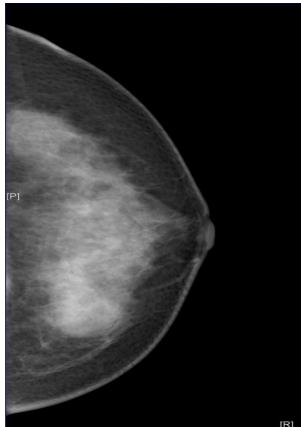
verywell

Well circumscribed

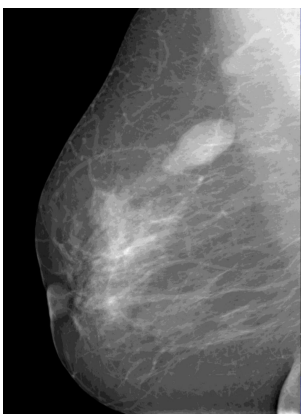
- ❖ Almost always benign
- ❖ 5% of them may be malignant .



Oval well circumscribed



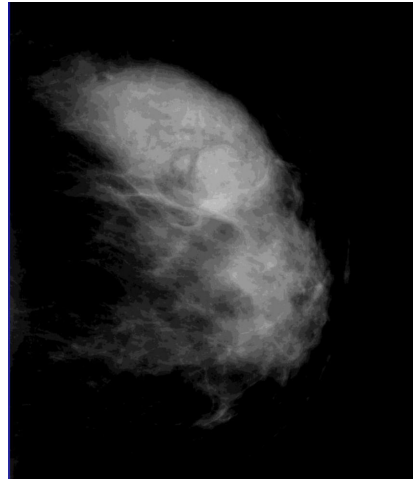
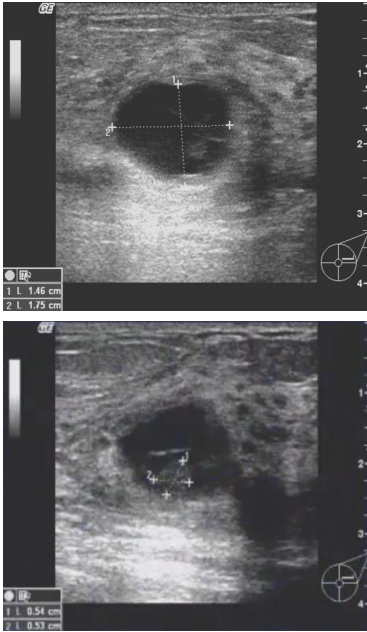
Large Fibroadenoma (benign)



Fibroadenoma (benign)



Hamartoma (Fibroadenolipoma)
 At US , a sharply defined , heterogeneous oval mass is seen , or the lesion may manifest as normal glandular tissue .



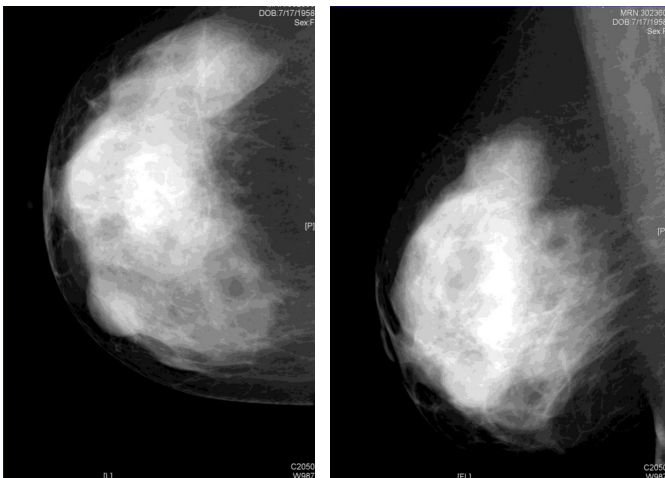
Hemorrhagic cyst in dense breast

» Density categories :

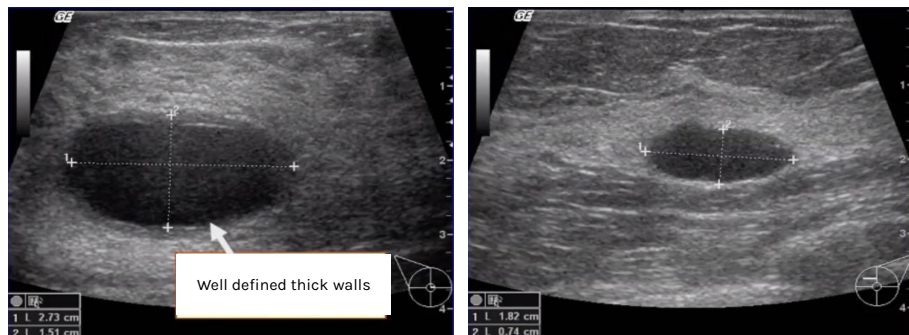
High Density	Clearly higher than surrounding , suspicious .
Equal Density	Density not appreciably different, neutral significance .
Low Density	Density lower, but not fat containing , neutral significance .

» Number of masses :

- ❖ Multiple well defined masses are probably **benign** .
- ❖ Multiple primary malignant lesions are obviously **ill defined** or **stellate lesions** .
- ❖ **Benign and malignant lesions CAN coexist !!**



Complicated cysts mammography



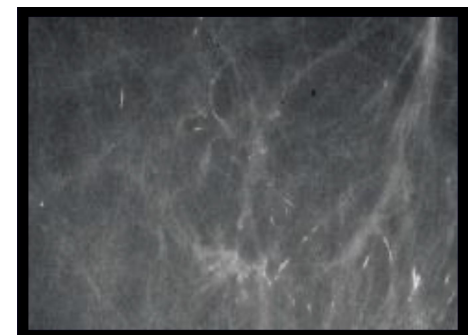
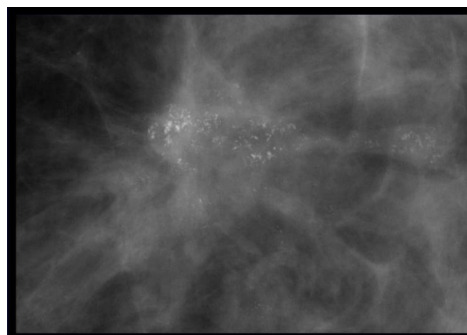
Complicated cysts US

Calcifications

Size	Number	Morphology
<ul style="list-style-type: none"> ❖ Micro calcifications : are associated with a malignant process . ❖ Macro calcifications : are associated with a benign process . ❖ 0.5 mm or less to have a high probability of association with cancer . ❖ 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 . 	<ul style="list-style-type: none"> ❖ Any number of calcifications less than four will rarely lead to the detection of breast cancer in and of itself . ❖ Two or three calcifications may merit greater suspicion if they exhibit worrisome morphologies . 	<ul style="list-style-type: none"> ❖ 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 broken glass and are rarely round or smooth .

Malignant Microcalcification

- ❖ Clustered : > 5 in 1 cm₂
- ❖ Branching interrupted ill-defined ductal .



» Breast Imaging Reporting system And Data System

The American College of Radiology (ACR) Breast Imaging Reporting and Data System (BIRADS) has classified findings of calcifications into three categories :

- Typically benign ;
- Intermediate concern ; and
- Higher probability of malignancy .

0	Incomplete	Additional imaging/ view required
1	Negative	Routine screening recommended
2	Benign	Routine screening recommended
3	Probably benign	(<2% malignant) 6 month short interval follow up
4	Suspicious of Malignancy	(>= 2% to 95% malignant) Biopsy should be considered
5	Highly suspicious of Malignancy	(>95% malignancy) Take appropriate action
6	Known Biopsy proven Malignancy	Malignancy

4 Pillars for Diagnosis of breast cancer :

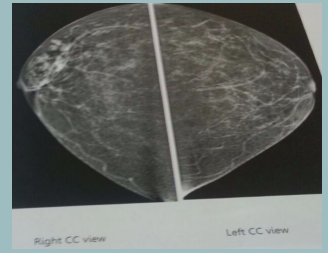
Clinical or Self Examination (PE)	Mammography (MG)	Ultrasound (US)	Magnetic Resonance Imaging (MRI)
	<ul style="list-style-type: none"> • Can rule IN cancer, but can not rule it OUT . • Not useful for dense breasts (< 30 y/o) 	<ul style="list-style-type: none"> • Indications : • Differentiation of both palpable and mammographic lesions as either cystic or solid . • Subsequent characterization and classification of solid nodules according to certain sonographic features . • Evaluation of palpable breast mass in patient younger than age 30 (very dense breast) . • Interventional procedures (BIOPSY) . • Identification of Malignant Features 	<p>- High-field strength (1.0 - 1.5 Tesla) necessary , resulting in :</p> <ul style="list-style-type: none"> - a higher signal-to-noise-ratio - shorter acquisition time - better separation of fat and water peaks - better contrast characteristics (T1 time increase) <p>Contraindicated in :</p> <ul style="list-style-type: none"> - Claustrophobia - Cardiac pacemaker or any metal prosthesis

In searching for Breast malignancies :

Mass : Margins is most imp character		Calcification
Spiculated margins	Well circumscribed (well-defined) margins	Morphology is most important indicator in differentiating Benign vs malignant lesions
<p>Classical carcinoma</p> <p>❖ DDx :</p> <ul style="list-style-type: none"> - Fat necrosis (previous surgical biopsy) - Scars (previous surgery) - Radio-opaque mark - Previous scar - Any increase in size → biopsy - Radial scar (complex sclerosing lesions) 	<p>❖ Almost always benign .</p> <p>❖ 5% of them may be malignant .</p> <p>❖ ultrasound :</p> <p>Cyst → No further assessment .</p> <p>Solid → Compression / magnification views :</p> <ul style="list-style-type: none"> - Microlobulated → Biopsy - Well Circumscribed → F/U 	<p>❖ Round and oval shaped calcifications that are also uniform in shape and size are likely benign .</p> <p>❖ Irregular in shape and size calcifications fall closer to the malignant end of the spectrum .</p> <p>❖ It has been described that calcifications associated with a malignant process resemble small fragments of broken glass and are rarely round or smooth .</p>

1-The abnormality seen in the shown mammogram is consistent with which ONE of the following?

- A- Lipoma
- B- Hamartoma
- C- Spiculated mass
- D- Intra-mammary lymph node



2-What's the most important character to differentiate between benign and malignant breast tumor ?

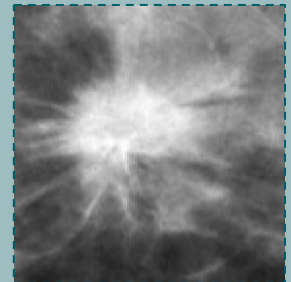
- A- Density
- B- Margins
- C- Shape
- D- Location

3-What is the best modality of breast imaging used for staging ?

- A- MRI
- B- Ultrasound
- C- Mammogram
- D- CT scan

4- describe the picture seen below :

- a. Circumscribed margin - benign
- b. Indistinct - intermediate probability of malignancy
- c. Spiculated - benign
- d. Spiculated- high probability of malignancy



5- from which of the following most breast cancer develop ?

- a. terminal ductal lobular unit
- b. Adipose tissue
- c. Areola
- d. Lobules

6- which of the following calcification character is considered benign lesion ?

- a. Irregular
- b. Micro calcification
- c. Broken glass fragment
- d. Round, oval

Answers
1)B
2)B
3)A
4)D
5)A
6)D