..th Lecture

MED437
King Saud University

RADIOLOGY TEAM 437

Color Index:

- ✓ Important
- ✓ Notes
- ✓ Extra

Radiology of the breast

Editting File

objectives:

- ➔ 1.Radiological anatomy of the breast.
- ➔ 2.Recognize the different modalities for breast imaging based on patient age.
- ➔ 3.Identify benign and malignant features of breast masses and calcifications.
- ➔ 4.Understand the Bl-RADS assessment (Breast Imaging and Reporting and Data System).

Sources

Lecturer:
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Same 436 lecture Slides:
YES

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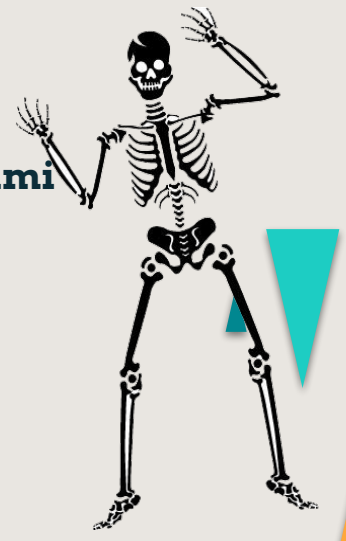


Revised by:

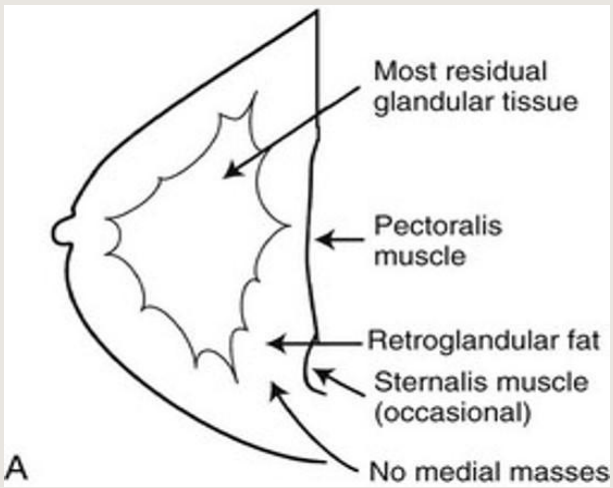
Aseel Badukhon

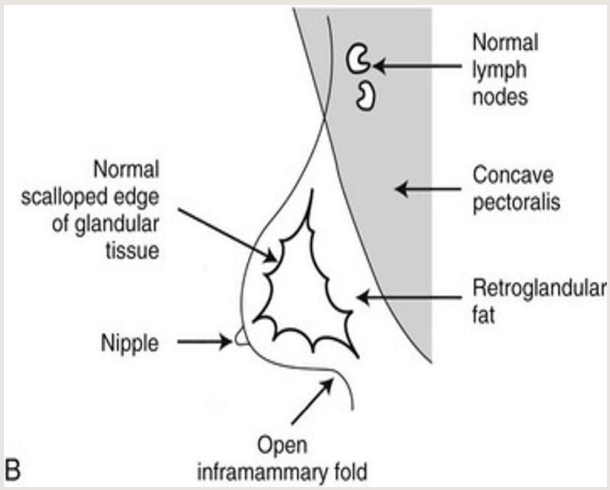
Lecture outline

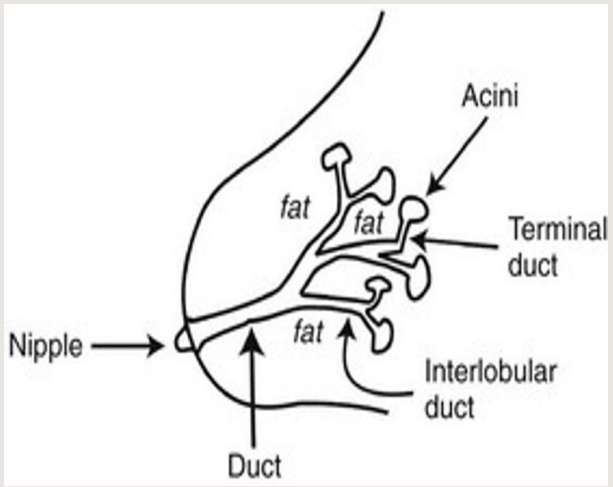
1. Basic anatomy
2. Breast cancer can be divided into two major groups
3. Breast Imaging
4. Modality and Age
5. Mammogram
6. Views
7. Ultrasound
8. MRI
9. Breast abnormalities
    a. Mass
10. Mass (shape)
11. Mass description
    a. Margins
    b. density
12. Benign Calcifications
13. Suspicious Calcification
14. Distribution
15. Architectural distortion
16. Bl-RADS Breast Imaging Reporting And Data System

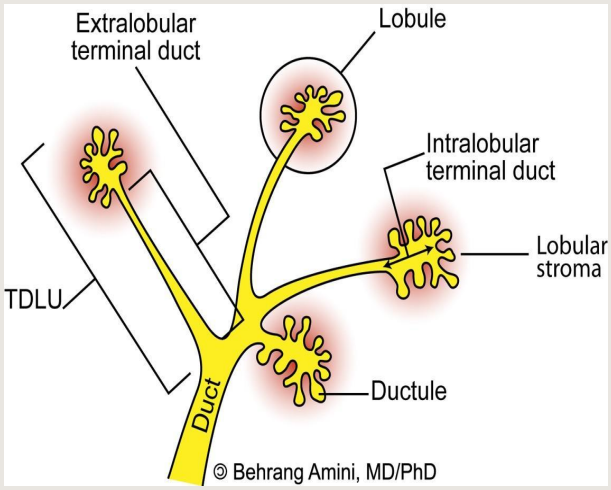
We advise you to study surgery team breast disease lecture before studying our lecture for better understanding

Basic anatomy:









Most breast cancer develops in the terminal ductal lobular unit (TDLU)

Ductal carcinoma is more common than lobular carcinoma

- **Borders:**
  - Upper border: Collarbone (clavicle).
  - Lower border: 6th or 7th rib.
  - Inner border: edge of sternum.
  - Outer border: mid-axillary line.
- **Divisions:** each breast is divided into 5 segments.

a) 4 quadrants:
2 inner: upper inner & lower inner.
2 outer: upper outer & lower outer.

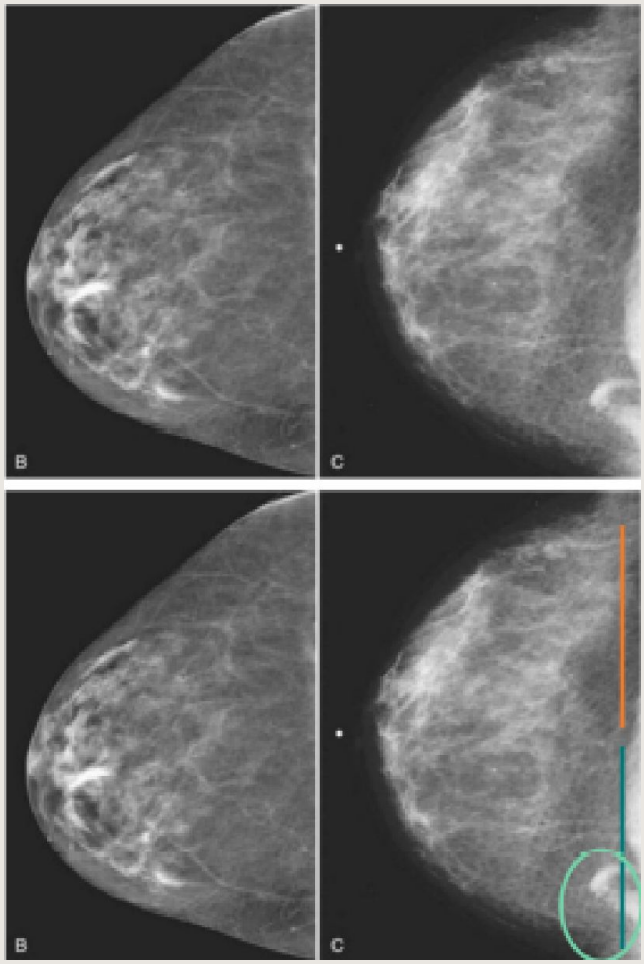
Majority of breast tumors arise in the upper outer quadrant.
b) Tail of spence (the axillary tail).

- Terminal ductal lobular unit is composed of:

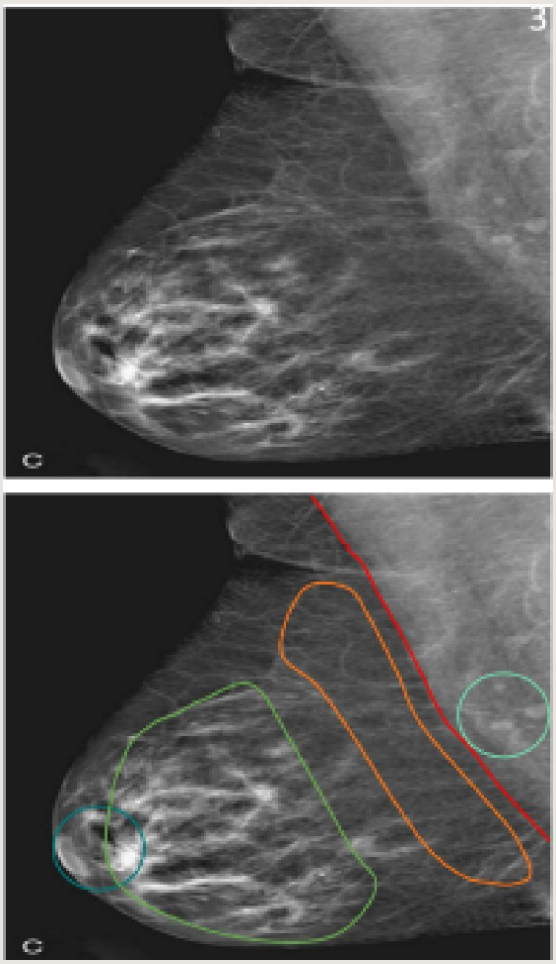
1- intralobular terminal ducts.
2- Acini.

Acini is the basic functional unit of the breast

Amazing video explains the whole lecture



Right breast *



1. Lateral aspect.
2. Medial aspect.

What's found in C and not in B?

The sternalis muscle.

- **Pectoralis muscle.**
- **Axillary lymph nodes.**
- **Retro-mammary or retroglandular fat.**
- **Nipple.**
- **Fibroglandular tissue (White).**

Breast cancer can be divided into two major groups

Digital mammogram is the most common modality used for breast imaging

IN SITU

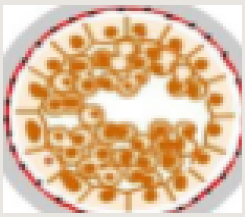
Tumor cells, they **do not** invade the basement membrane.

Tumor cells remain confined to the ducts or lobules.

INVASIVE

Tumor cells **invade** the breast stroma.

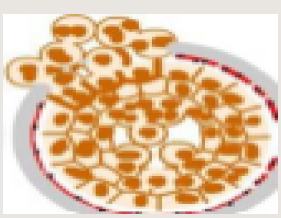
They have the potential to metastasize and result in death of the patient.



DCIS

The membrane here is intact

*Diagnosis is important because the prognosis differs from early to late stage

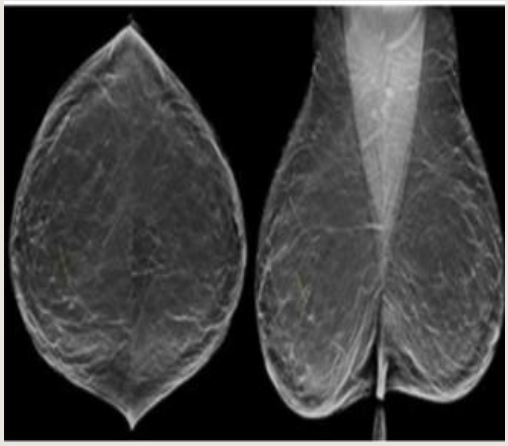


Invasive ductal carcinoma

The membrane here is invaded

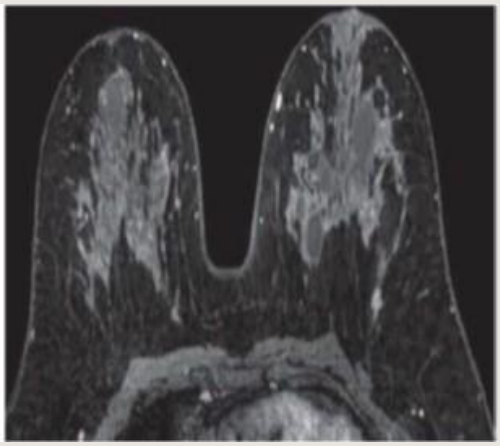
* How to know if this is the right or the left breast on a mammogram?
Look at the nipple, if it is to the left then this is the RIGHT breast and vice versa

Breast Imaging



Mammogram

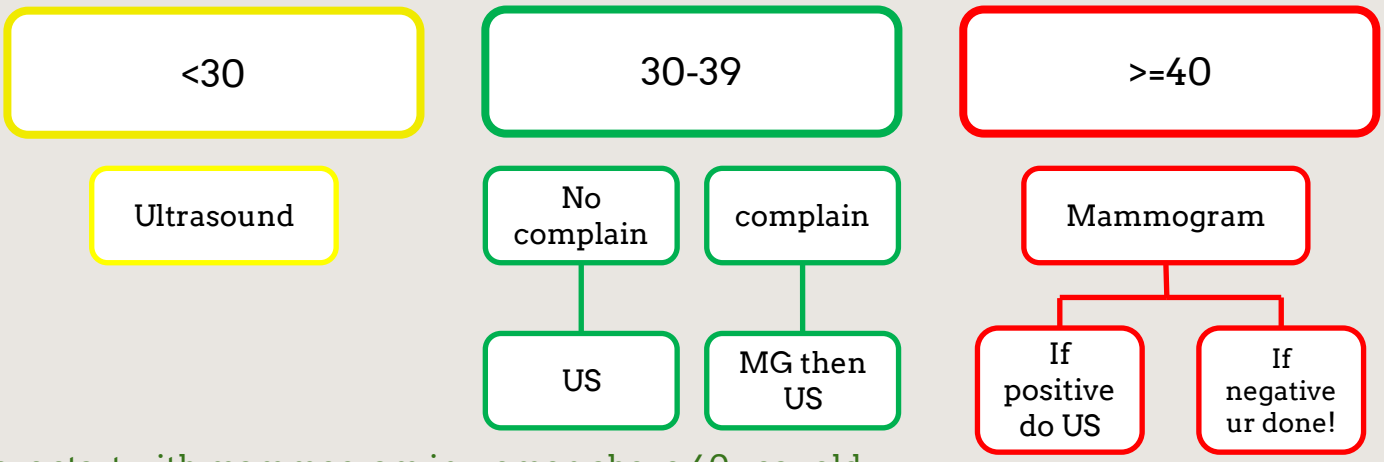
Ultrasound



MRI

US is preferred because:
* Low radiation.
* Glandular tissue is more than the adipose tissue.

Modality and Age



Always start with mammogram in women above 40 year old

Mammogram

Mammography should be avoided in females age less than 30 as much as possible cause of radiation

Mammogram Indications:

a) 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 BRCAl & 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.

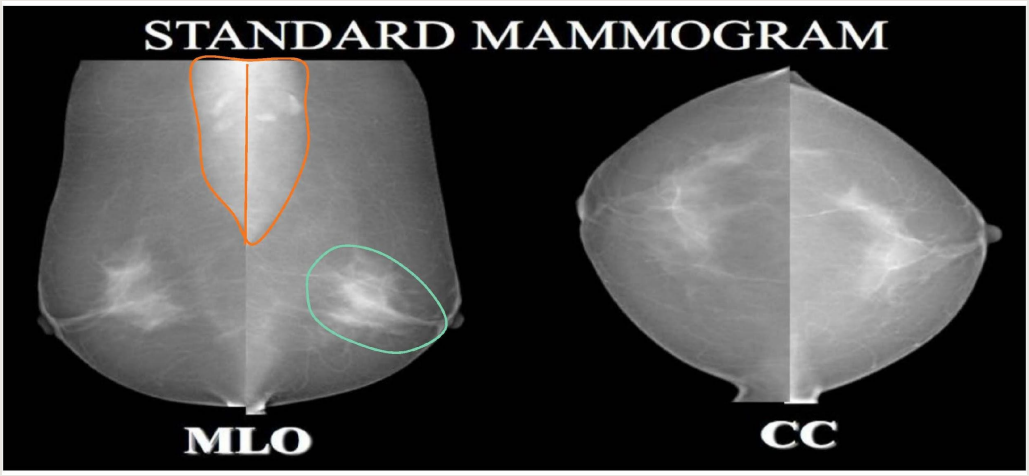
b) Diagnostic (Complain):

1. Palpable mass.
2. Nipple discharge.
3. Skin changes.

Breast mammogram

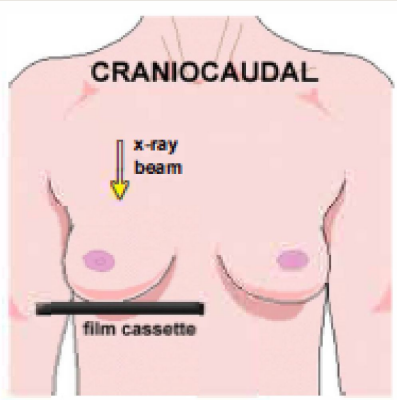
Views

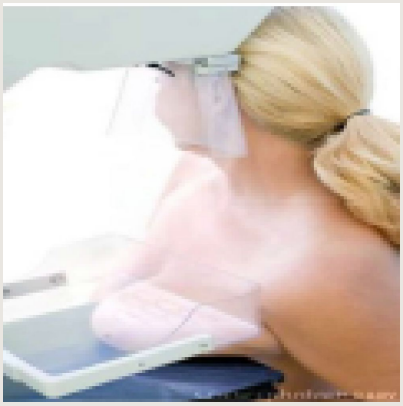
We have 4 views: Rt MLO, Lt MLO, Rt cc and It cc.
We can see the inframammary fold and pectoralis muscle in MLO view only

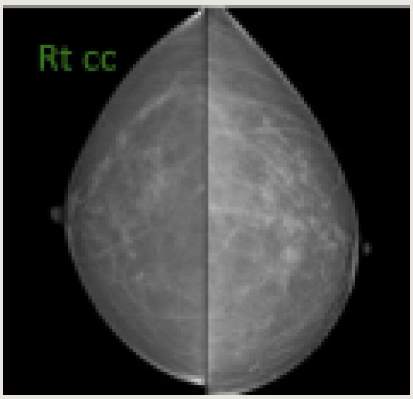


Original image

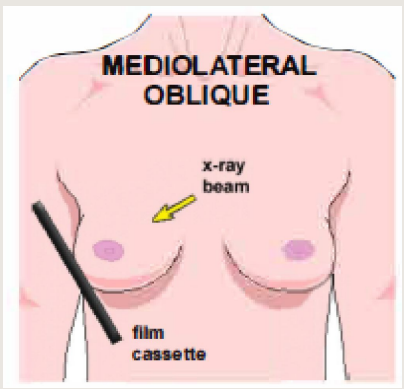
- Pectoralis muscle and axillary lymph nodes.
- Fibroglandular tissue.

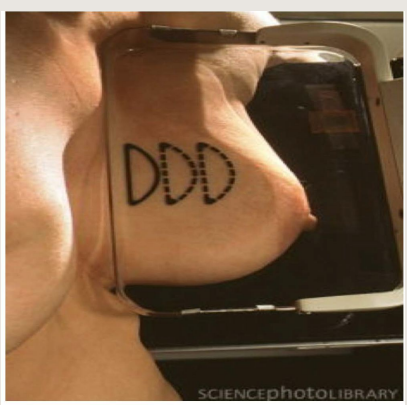




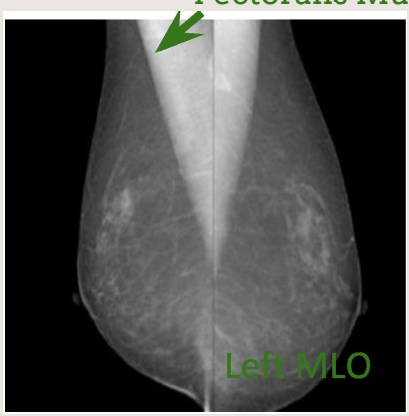


In cranial-caudal (CC):
Only in 15-20% of cases you can appreciate Pectoralis major muscle.
- The breast is compressed from up to down, with zero angulation.





Pectoralis Muscle



In mediolateral-oblique (MLO):
You can appreciate Pectoralis major msc and the Axillary lymph nodes.
- The breast is compressed from medial to lateral, with 45 degree angle.

In mammogram we check shape, density and margins.
In ultrasound we check margins margins margins!!!

Breast Ultrasound Indications:

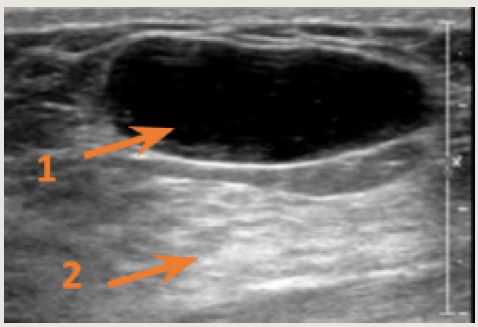
1. Differentiation of both palpable and mammographic lesions as either cystic or solid.
2. Evaluation of solid masses according to certain sonographic features.
3. Initial imaging evaluation of palpable breast masses in patients under 30 years and in lactating and pregnant women.
4. Screening for occult cancers in certain populations, including of women with heterogeneously or extremely dense breasts.
5. Follow-up of breast cancer treated with neoadjuvant chemotherapy.
6. Guidance for breast biopsy and other interventional procedures.

Sometimes we follow up with MRI.

Malignant VS Benign sonographic features of solid masses:

Benign	Malignant
Circumscribed, hyperechoic (can be hypoechoic)	Spiculation
Parallel oriented - wider than taller	Angular margins
Gently curving smooth lobulations	Hypoechogenicity
Thin echogenic pseudocapsule	Shadowing
	Calcification
	Duct extension
	Branch pattern
	Microlobulation

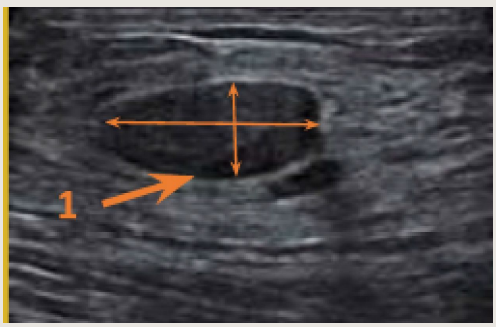
The benefit from US is to differentiate between cyst and solid lesions:



Cyst

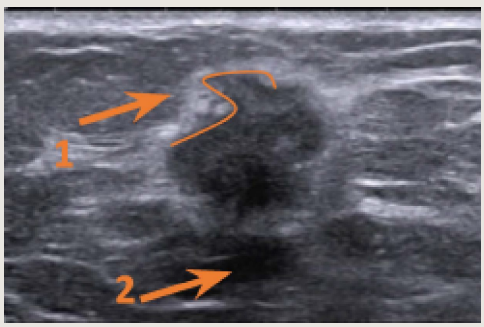
1. Anechoic cyst.
2. Posterior enhancement.

Well defined.Typical cyst and cyst is always benign.



Solid (benign)

1- Echogenic capsule. Circumscribed, wider, larger and parallel. Posterior shadowing is usually central, this doesn't have a shadow.



Solid (malignant)

1. Spiculated.
2. Shadowing.

A little bit hypoechoic and irregular.

MRI

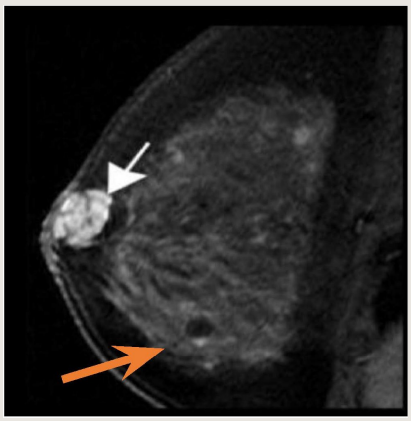
MRI Indications:

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

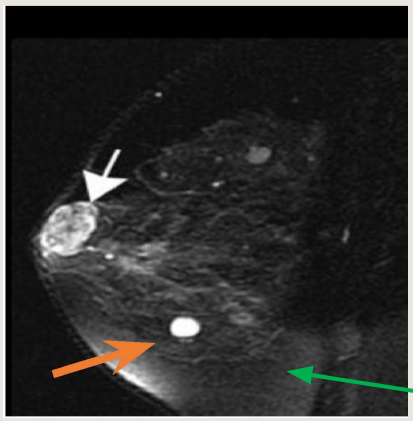
Chest MRI Equipments

MRI breast-Minimum equipment:

- System with field strengths 1.5 T.
- Dedicated bilateral breast surface coil.
- Prone positioning (the best position to perform breast MRI).
- Images obtained prior to gadolinium and multiple phases following gadolinium administration (Dynamic).

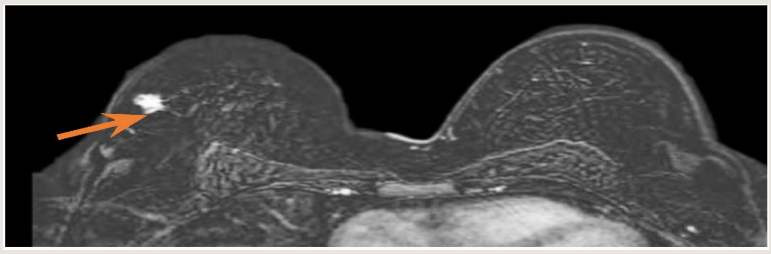


Tl fat sat with Gadolinium
fluid will appear hypointense which indicates cyst



T2 fat saturation

If we have something high signal intensity in T2 this is either a mass like fibroadenoma, mucinous cancer or cyst. Compare the lower lesion (cyst - orange arrow) in Tl and T2, it's high signal in T2 and low signal in Tl because it's water, meanwhile the upper lesion (mass - white arrow) is high signal in both Tl and T2 (enhanced post contrast) so this is enhancing mass with dark septation typical for malignancy.



In the right outer aspect, small irregular suspicious lesion because of its irregular margins. Always check the margins. We check paralleling in ultrasound only.

Subtracted images = Enhances - Unenhanced images

Breast abnormalities

Mass

Calcification

Architectural distortion

Skin thickening

Nipple retraction

Axillary lymph nodes

Margins

Malignant

Benign

Shape

Density

Only seen in mammogram

Nipple inversion: بتقولك المريضة انه من انولدت و هي كذا

Nipple retraction: هذي جديدة تو ها طلعت لها

a) Mass

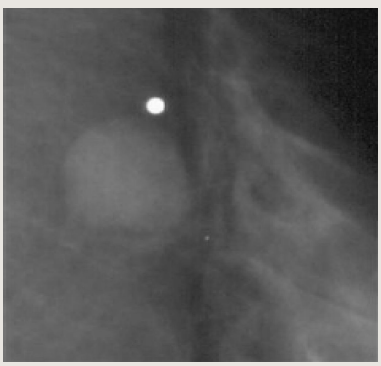
- Both views CC & MLO.
- Persist (spot compression view) to magnify the mass.

(**AKA** compression mammogram, cone views, or focal compression views where they apply the compression to a smaller area of tissue for better evaluation). Read more.

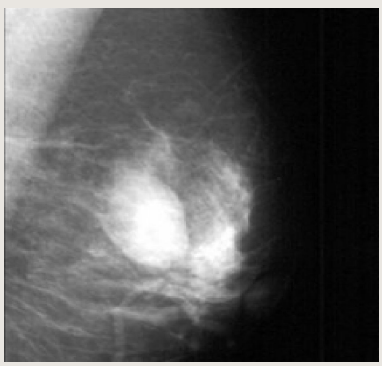
- Shape.
- Margins (the most important feature).
- Density.
- In addition to location.

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

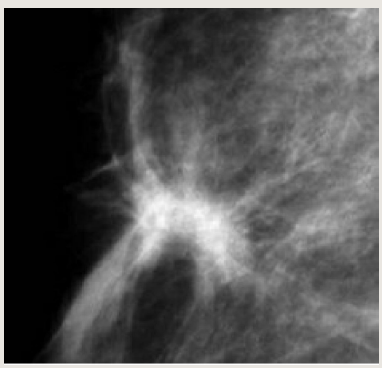
Mass (shape)



Rounded



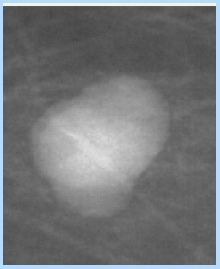
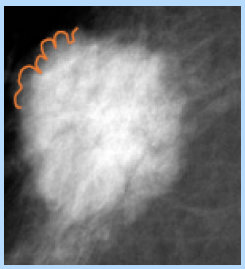
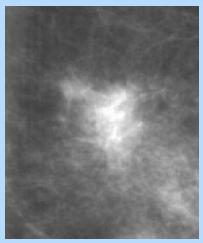
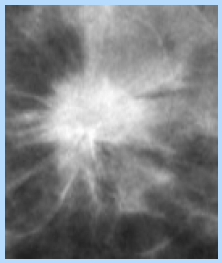
Oval



Irregular (suspicious) (more with aggressive mass)

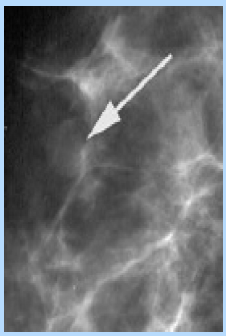
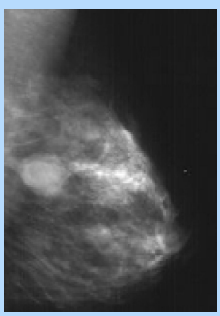
Mass description

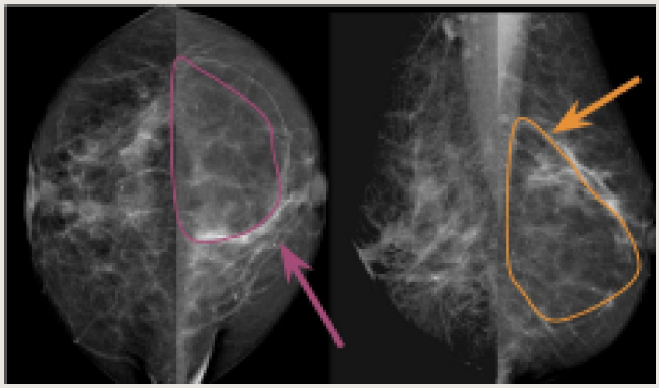
a) Margins (extremely important)

Circumscribed More with benign	Obscured More with benign	Microbleed Less probability to be malignant	Indistinct Intermediate probability to be malignant	spiculated High probability to be malignant
كأنه مرسوم بقلم Abrupt transition between lesion and t issue. DDx: 1. Cyst. 2. Fibroadenoma (Breast mouse) . 3. It can be lipoma, but lipoma should be loosened and this is dense.	Margins (suspected to be circumscribed) hidden by adjacent superimposed normal tissue. Ask for compression or magnification views. Totally or partially obscured (usually benign).	Margin undulated with short cycle 1-2 mm (suspicious).	ill defined. Possible infiltration (more suspicious).	Lines radiating from margins of a mass (from a DENSE center). DDx: 1. Cancer. 2. Surgical scar. 3. Fat necrosis. The chance of malignancy is above 95% (most suspicious).
				

Most of the time benign but the lesion margins are important

b) Density

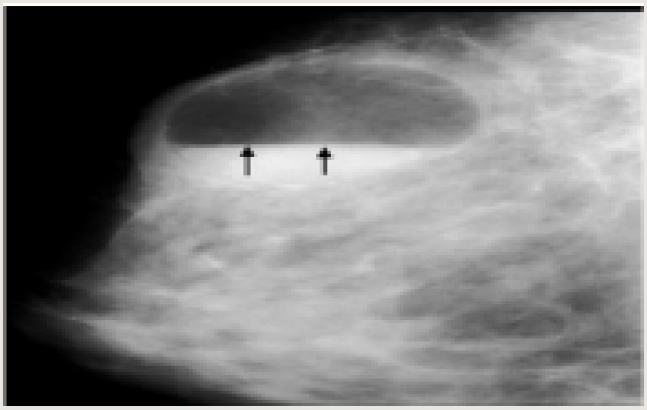
Fat only	Mixed density	Low dense	Equal dense	High dense
DDx 1. Oil cyst/fat necrosis, post surgery/ trauma. 2. Lipoma, if you see a mass, its benign.	DDx: 1. Hamartoma (it's a breast within the breast). 2. Inframammary lymph nodes. 3. Fat necrosis. 4. Galactocele (lactating women comes complaining of mass decreases in size after lactation) if you see a mass, it's benign.	DDx: Cyst.  Cancer is less likely but still possible.	DDx: 1. Cyst 2. Fibroadenoma 3. Cancer.  Cancer is less likely but still possible.	Cancer.  Most of the time suspicious.

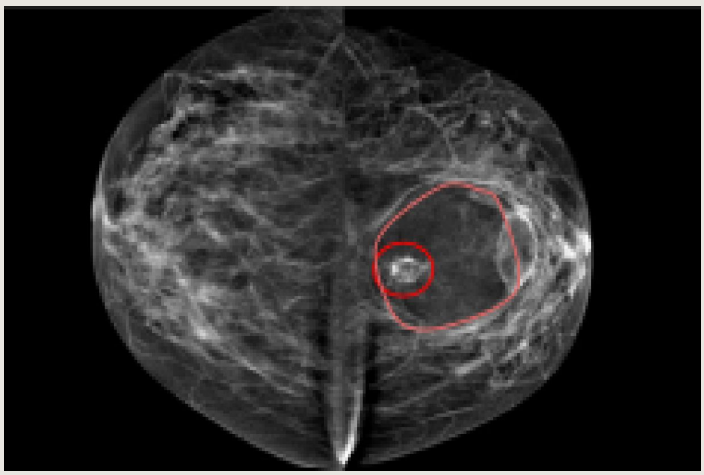


Click here to see original image

Lipoma:
It's circumscribed with very clear margins This is all a mass and the glandular tissue here is pushed up. Meanwhile here it's pushed to the medial side. Lucent (gray) lesion with thin dense (white) capsule represents the pushed breast parenchyma.

Galactocele:
Fat-Fluid Level, this is typical for mixed density lesion and galactocele, just like water and oil, Fat is oil so it will flow and milk which represents water will go down, high risk of infection. The surrounding tissue is highly dense because of lactating. .





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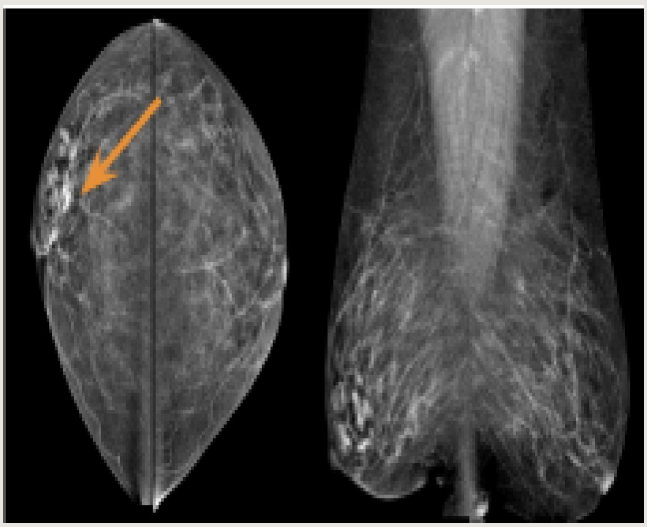
Fat necrosis:
The only difference between fat necrosis and lipoma is the presence of dystrophic calcification in case of fat necrosis. It is benign.

Hamartoma (Fibroadenolipoma):
The abnormality is in the right breast, retroareolar area, mixed density mass. It's called (breast in a breast mass) typical for hamartoma.

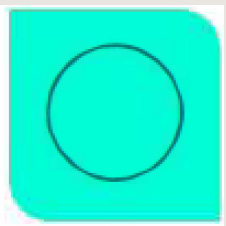
- **Mammogram:** Partially circumscribed oval mass with some obscured margins.
- In **US**, a sharply defined, heterogeneous oval mass is seen, or the lesion may manifest as normal glandular tissue.
- It is not considered a malignant tumor.
- Mostly asymptomatic.
- No need for biopsy or follow up.



Benign Calcifications

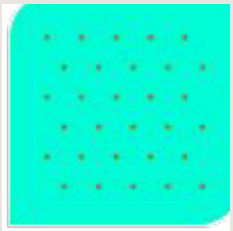

Skin


Vascular


Rim

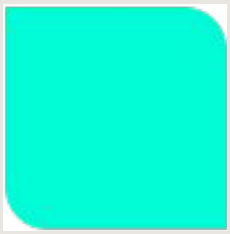
Popcorn


Rod-Like


Punctate


Milk of calcium


Suture

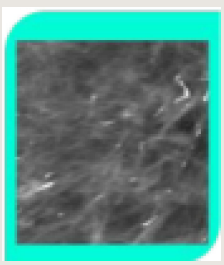

Dystrophic

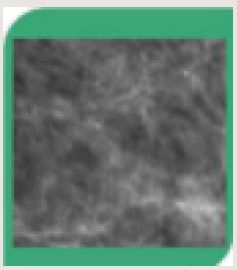

Skin

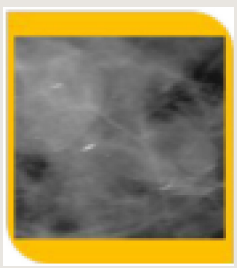

Vascular


Rim

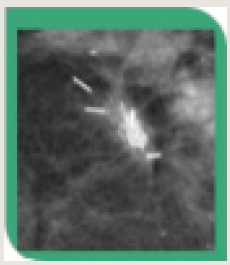

Popcorn


Rod-Like


Punctate


Milk of calcium

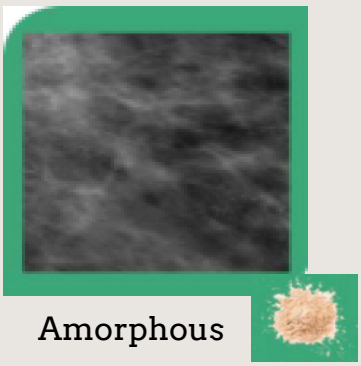

Suture


Dystrophic

1. Skin: Multiple rim shaped skin/dermal calcification, ring-like with central lucency.
2. Vascular: Calcifications along the blood vessel.
3. Rim: Remember fat necrosis case? With The rim calcification and internal dystrophic calcification. DDx: Fat necrosis/Oil cyst.
4. Popcorn: Typical for calcified fibroadenoma (involuted fibroadenoma).
5. Rod-like: Sharply demarcated.
6. Punctate: Tiny dots.
7. Milk of calcium: Small layering calcification within the cyst.
8. Suture: Post surgery along suturing line.
9. Dystrophic: Fat necrosis post surgery/trauma (and breast trauma is not a risk factor for breast cancer)

Suspicious Calcification more with malignant

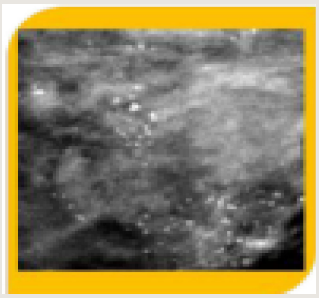
suspicious:
1st is fine branching and linear branching
2nd is fine pleomorphic



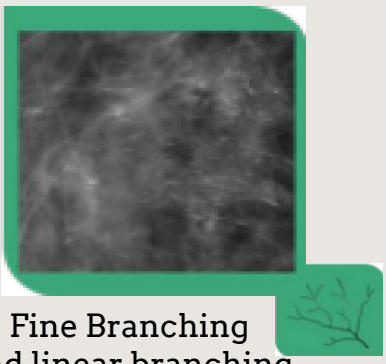
Amorphous

The dots here are smaller than in the punctate calcification.

Coarse heterogeneous
looks like the popcorn but smaller in size, irregular in shape



Fine Pleomorphic
different in size, shape, density.

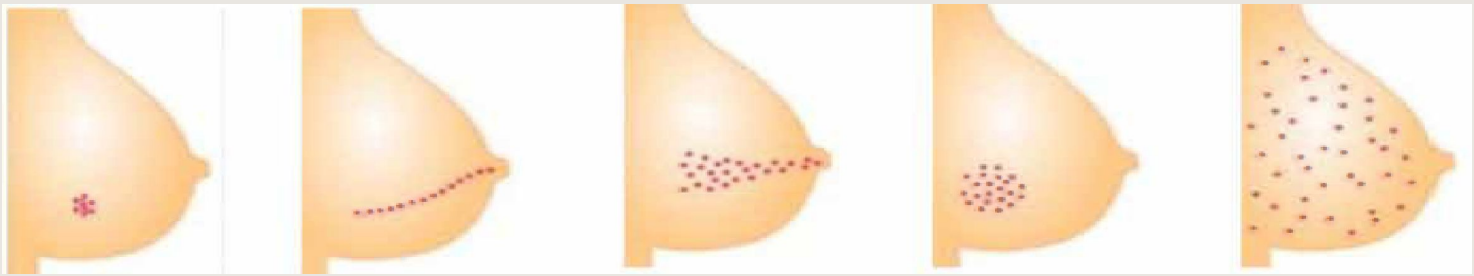


Fine Branching and linear branching

Most suspicious! differentiate between this and milk and rod-like benign calcification.

Distribution

After commenting on the calcification, you must describe the distribution.



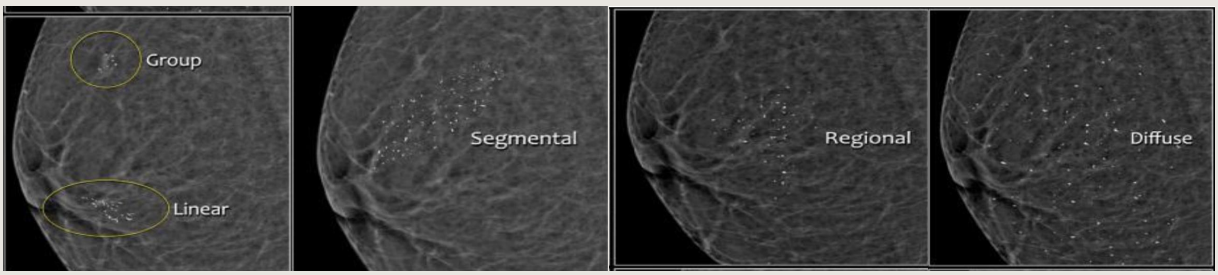
Grouped
< 2cm
(must be 5 Suspicious calcifications to Arranged in lines consider it group)

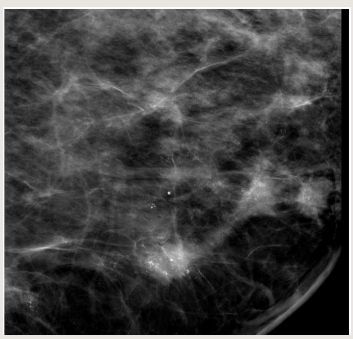
linear
Suspicious
Arranged in lines within ductules

Segmental
Suspicious
Multiple lines towards the nipple

Regional
>2cm

Diffused
Entire breast





Grouped Calcifications
7 different groups

Size:
- Micro calcifications are associated with malignant processes; Macro calcifications are associated with benign processes. 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.

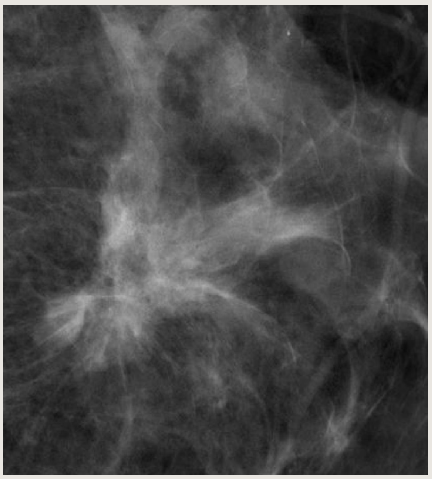
Morphology:
- Round and oval shaped calcifications that are also uniform in shape and size are likely benign.
- Irregular in shape and size calcifications fall closer to the malignant end of the spectrum.

Architectural distortion

- Lines radiating from a point
- Focal retraction/distortion of parenchymal edge
- Main findings or associated findings, a patient with distortion only or with suspicious mass in addition to distortion

Differential diagnosis:

1. Breast cancer. (most of the time is invasive lobular carcinoma)
2. Radial Scar (complex sclerosing lesion).
3. Surgical Scar.



How to differentiate between architecture distortion & spiculated mass?
In architecture distortion the lines are radiating from a LUCENT center. If you see architectural distortion ask the pt if she has ever had a surgery, because if she has it will be not necessary to do further investigation or biopsy, the surgery might be the cause of the distortion.

BI-RADS
Breast Imaging Reporting And Data System

The system is Made from the American College Of Radiology to standardize the reports.

0	**Incomplete** exam, Additional imaging/view is recommended.
1	**Negative** no abnormalities at all, Routine screening recommended.
2	**Benign** like cyst, fibroadenoma, hamartoma and fat necrosis, Routine screening recommended.
3	**Probably Benign**(< 2% malignant); six-month short interval follow-up.
4	**Suspicious of Malignancy** (≥ 2 to 95%); biopsy should be considered.
5	**Highly Suspicious of Malignancy**(> 95%); take appropriate action .
6	**Known Biopsy-Proven Malignancy**

known malignancy (example: a patient diagnosed with breast cancer and is on chemotherapy, imaging was done to assess response to chemotherapy; the cancer is still there but is bigger/smaller/or stable).
However, if the patient had breast cancer in the past and her status post treatment and surgery and current imaging only has post surgical changes with no suspicious findings then this is BIRADS 2 (she's already diagnosed with cancer and just come to follow up).

SUMMARY

Anatomy of breast	
External anatomy: -Nipple. -Areola. -Glands of Montgomery	**Internal anatomy:** -Glandular tissue. -Fibrous (supporting): cooper's ligaments. -Fatty tissue.

Best Modality (depend on AGE)		
< 30: Ultrasound.	**30-39:** if no complain do US, complain do mammogram then US.	**> 40**: mammogram, if +ve do US.

Indication		
Ultrasound : -Differentiation between cystic or solid. -Initial imaging evaluation in lactating and pregnant women. -Screening -Follow-up -Guidance for breast biopsy	**Mammogram :** -screening (The patient has no complaints). -Diagnostic (The patient has a complaint).	**MRI :** -Staging -High risk patients -Monitoring response to therapy. -Occult breast cancer. -Assess the contralateral breast. -Breast implant

Breast Abnormality		
1-Mass (shape , Margins , Density)	2-Architectural Distortion.	3-Calcification (Benign , Suspicious)
4-Skin thickening	5-Nipple retraction	6-Axillary lymph nodes.

SUMMARY

Mass

Mass shape:	**Mass Margins:**	**Mass Density**:
-Rounded. -Oval. -Irregular (Suspicious)	-Circumscribed. -Obscured. -Microlobulated (suspicious). -Indistinct (more suspicious). -Spiculated (most suspicious).	-Fat only. -Mixed density. -Low dense. -Equal dense. -High dense (suspicious).

Calcification

Benign :	**Suspicious :**
-Skin: ring-like. -Rim. -Popcorn: involuted fibroadenoma -Rod-like: sharply demarcated -Punctate: tiny dots. -Milk of calcium: layering. -Suture: post surgery. -Dystrophic: fat necrosis.	-Amorphous. -Coarse heterogeneous. -Fine pleomorphic. -Fine branching and linear branching.

BI-RADS
Breast **I**maging **R**eporting **A**nd **D**ata **S**ystem

0	**Incomplete :**Additional imaging/view
1	**Negative :** Routine screening recommended.
2	**Benign :**Routine screening recommended.
3	**Probably Benign :** (< 2% malignant); six-month short interval follow-up.
4	**Suspicious of Malignancy** : (>2 to 95%); biopsy should be considered
5	**Highly Suspicious of Malignancy:** (> 95%); take appropriate action.
6	**Known Biopsy-Proven Malignancy known breast**

QUESTIONS

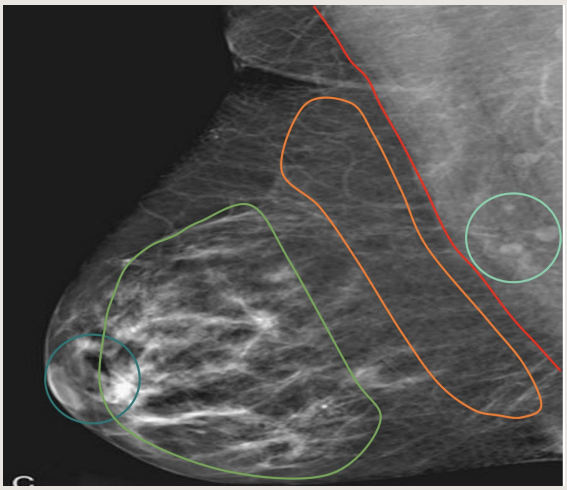
1-What is the structure in green in the following mammogram image of the breast?

a) Retromammary fat.

b) Fibroglandular tissue.

c) Nipple.

d) Pectoralis muscle.



2-All of the following is a malignant feature of breast mass except for:

a) Duct extension.

b) Thin echogenic pseudocapsule.

c)Spiculation.

d) Shadowing

3-All of the following is an example of Suspicious calcification except:

a)Coarse heterogeneous.

b)Fine branching and linear branching.

c) Punctate

d) Amorphous

4-An important feature to distinguish lipoma from fat necrosis is:

a) The dystrophic calcification.

b) The location of the glandular tissue.

c)The heterogeneity..

d) The circumscribed margins.

5-A 34-year-old women came to your clinic complaining of greenish breast discharge started a month ago. Which of the following will be used to investigate the problem?

a)Mammogram..

b) MRI

c)Ultrasound.

d) Mammogram then Ultrasound.

6-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) screening mammography of both breasts

b) magnetic resonance imaging of both breasts

c)ultrasound of both breasts.

d) breast screening is not appropriate for a patient of this age

Answers : 1-B 2-B 3-C 4-A 5-D 6-B

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RadiologyRadiology437@gmail.com

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References

✓ Slides
✓ 436 Teamwork

slidesgo

You did it !