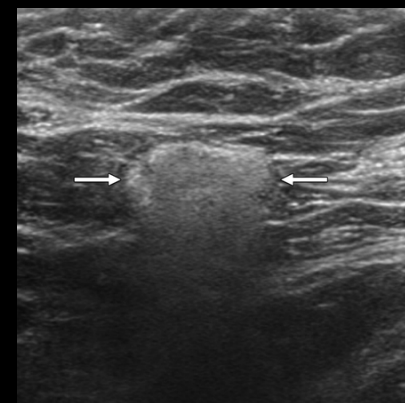
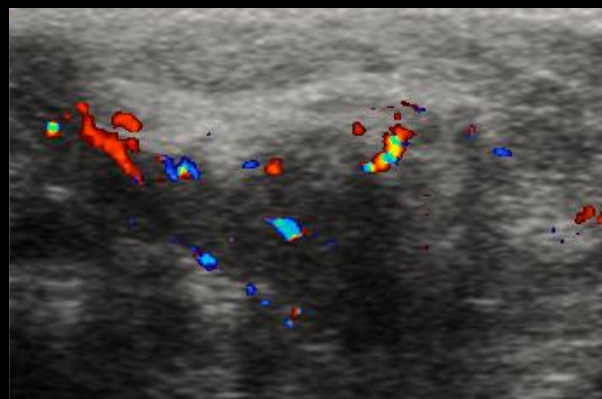
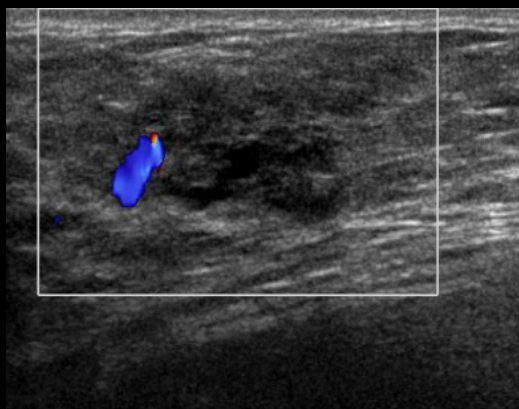




2014 CME SONOGRAPHER DAY



Breast Ultrasound: Protocols, Pearls & Pitfalls – Part 1



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April 6, 2014

Overview

3 things to ask yourself for every breast US that you do:

1. “Why is this patient here?”
2. “Could this be cancer?”
3. “Have I shown the finding well enough?”

Overview

- Screening vs. Diagnostic Ultrasound
- Basic Breast Ultrasound Protocol & Positioning
- Background Breast Parenchyma - a limitation?
- **Breast Cancer features on US**
- Cysts
- Dilated Ducts
- Breast Implants
- Gynecomastia
- Cases

Q1. “Why is this patient here?”

Screening vs. Diagnostic Breast US

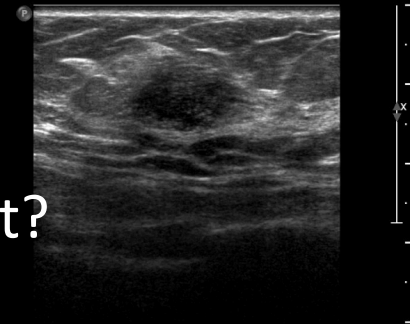
- Screening

- asymptomatic
- low pre-test probability
 - (i.e. more likely to be negative, since pt does not have a breast concern)



- Diagnostic

- Patient presents with a breast concern
 - Lump? Pain?
 - Nipple discharge? New Nipple Inversion?
 - Skin changes? Change in shape of the breast?

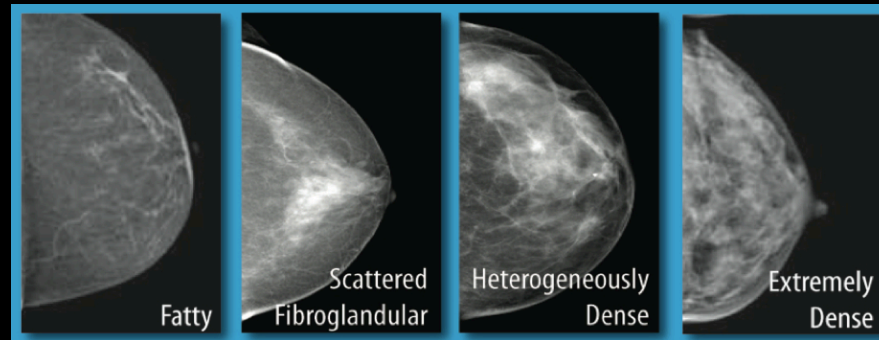


Screening Breast US

- Only as a supplementary tool to mammo
 - Mammography is still primary screening modality for breast cancer

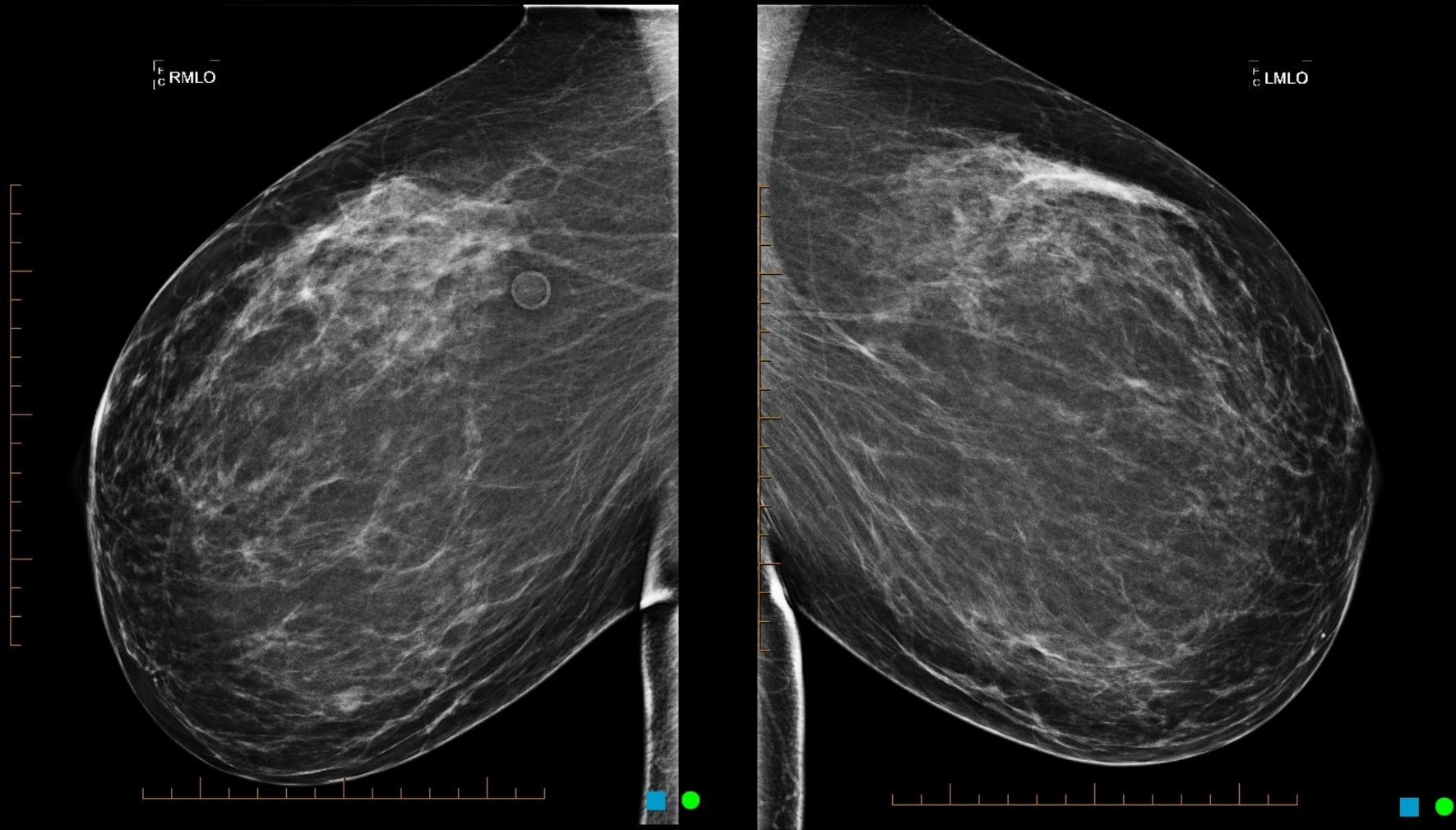
Screening Breast US

- Useful for dense or heterogeneously dense breasts on mammo to increase exam sensitivity



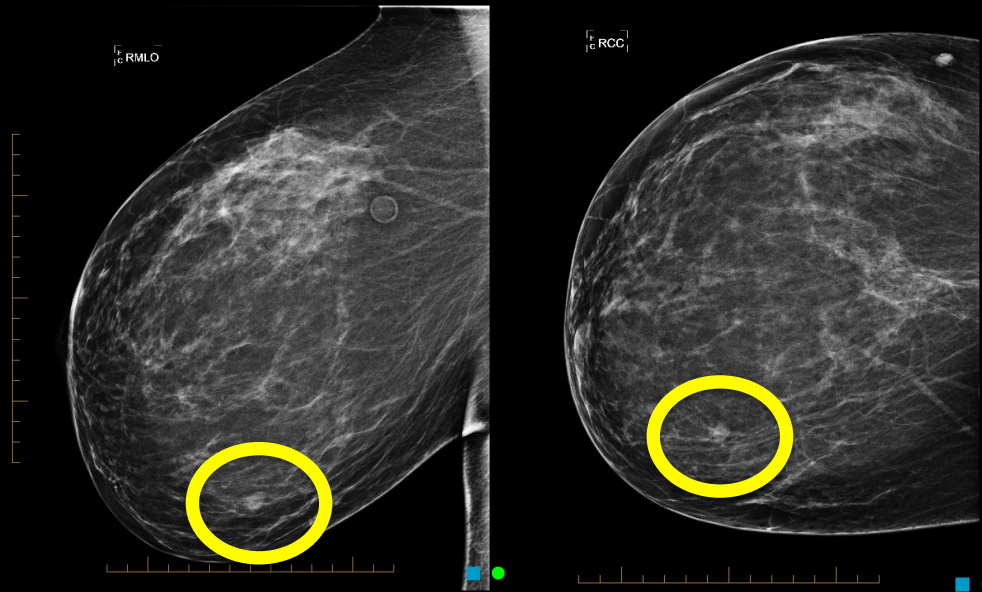
- Especially if there are risk factors:
 - Dense breasts ~ 4-6X risk
 - Family Hx - mother OR sister w/ breast ca <50 ~ 3X
 - Family Hx - 2+ family members w/ breast ca ~ 3X
 - Personal Hx of breast ca ~ 3-4X

Clinical Indication: “Routine”



Screening Breast US

- Ask the Mammo technologist if there is any area on which to focus



“Right lower inner quadrant” or “Right breast ~5:00, 4-5 CMFN”

Diagnostic Breast US

i.e. Patient has a breast concern:

1. Read the Clinical Requisition
2. ASK THE PATIENT

- **New Symptoms?**

- Or for years? (eg “nipple inversion since I was a teen”)

- **Lump?**

- Pain?

- Nipple discharge? (bloody? Clear?)

- New Nipple Inversion?

- Skin changes?

- Change in shape of the breast?

OTHER (Please specify):

BREAST IMAGING

☒ MAMMOGRAM ☒ BREAST ULTRASOUND

X-RAY (Please Specify)

BONE DENSITOMETRY AXIAL BONE DENSITOMETRY OF HIP AND SPINE

☐ HIGH RISK (ONCE A YEAR) ☐ ROUTINE (EVERY 5 YEARS)

CLINICAL INFORMATION

↑ density / thickened since nipple retract

② breast no specific mass

Q1. “Why is this patient here?”

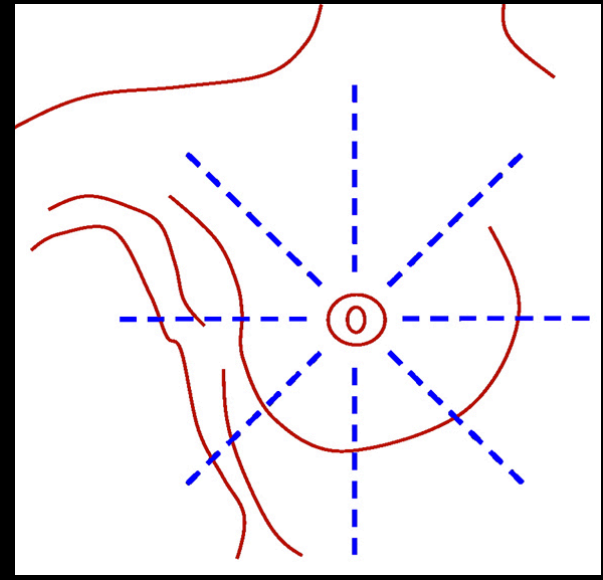
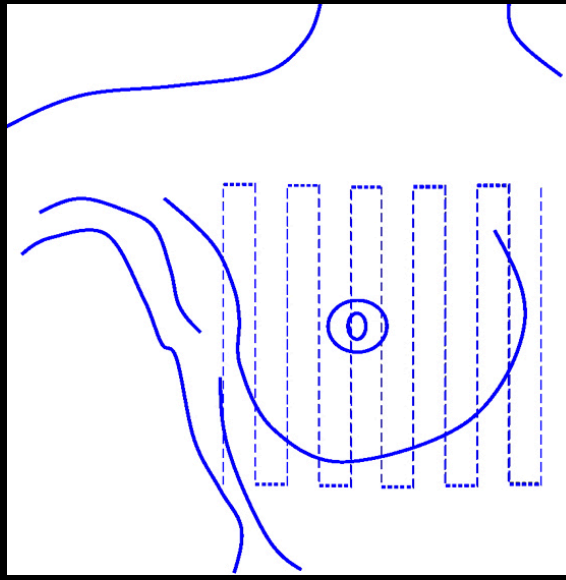
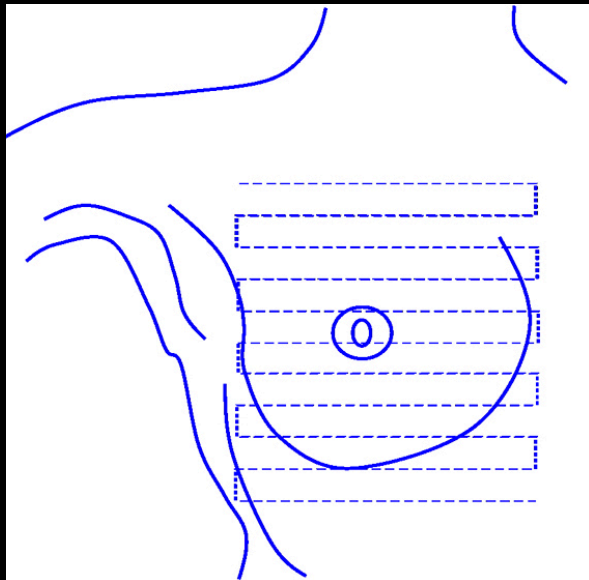
Diagnostic Breast US

- Sonographers
 - have the “hands-on” perspective
 - are the “eyes & ears” of the radiologist
 - If you observe suspicious clinical features (eg. lump is hard, firm, fixed vs. benign-mobile, soft),
mention on tech sheet (circle, *)
 - Label Area of Concern (AOC)



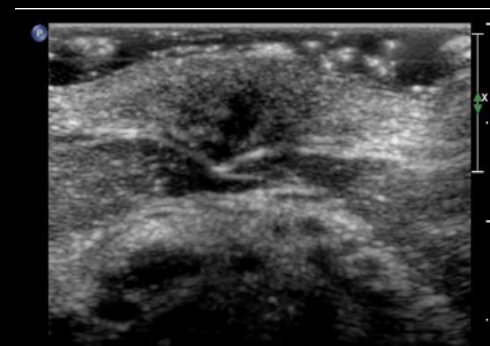
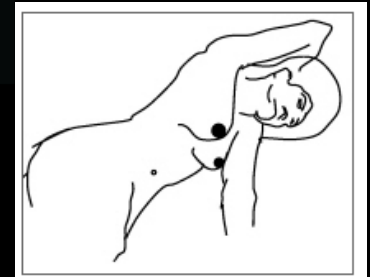
Basic Breast US Protocols

- Systematic Method of scanning
 - Eg.
 - Raster (horizontal, then vertical, overlapping)
 - Radial (going out from the nipple, still overlapping)



Basic Breast US Protocols

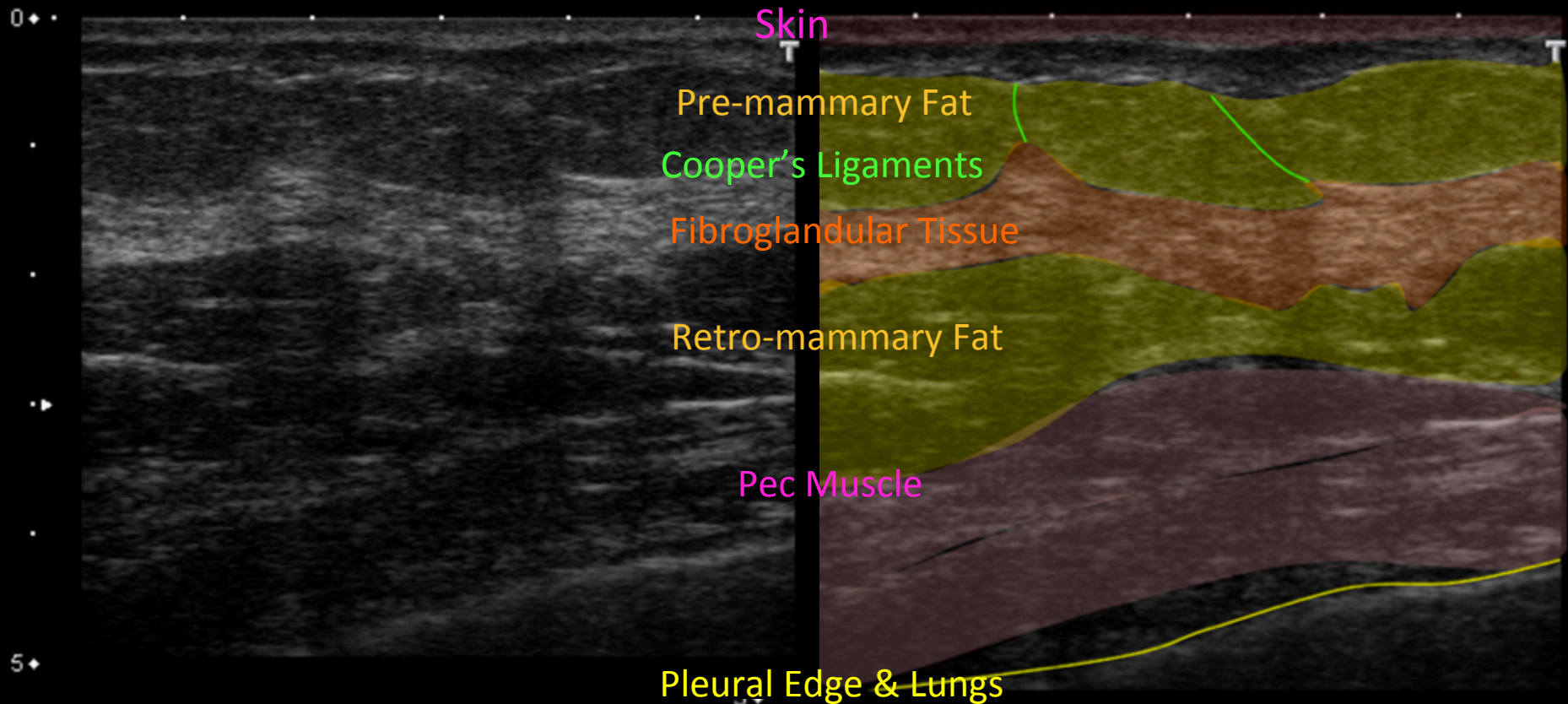
- Lateral Lesion?
 - OBLIQUE patient, arm up
 - Large breasts?
 - have pt roll onto her SIDE
- Stand off pad (lots of gel)
 - For superficial lesions
 - eg. epidermal inclusion (aka sebaceous) cyst
 - nipple



RIGHT NIPPLE

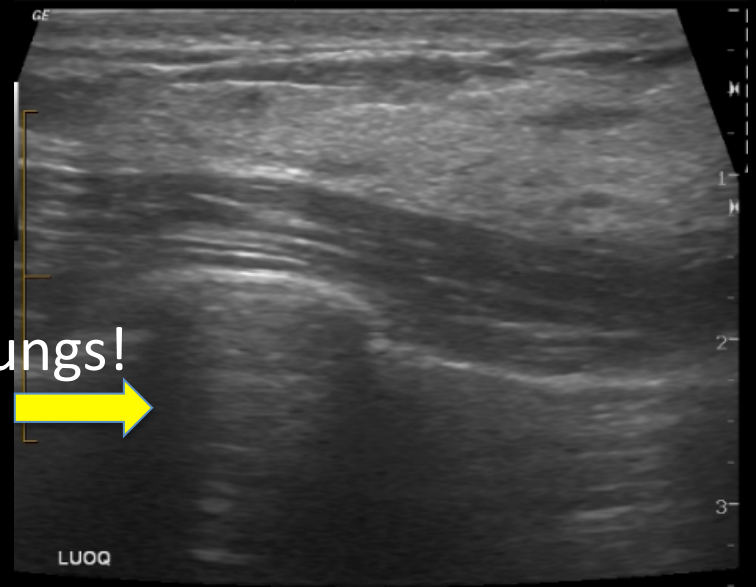
Basic Breast US Protocols

- Breast Anatomy:



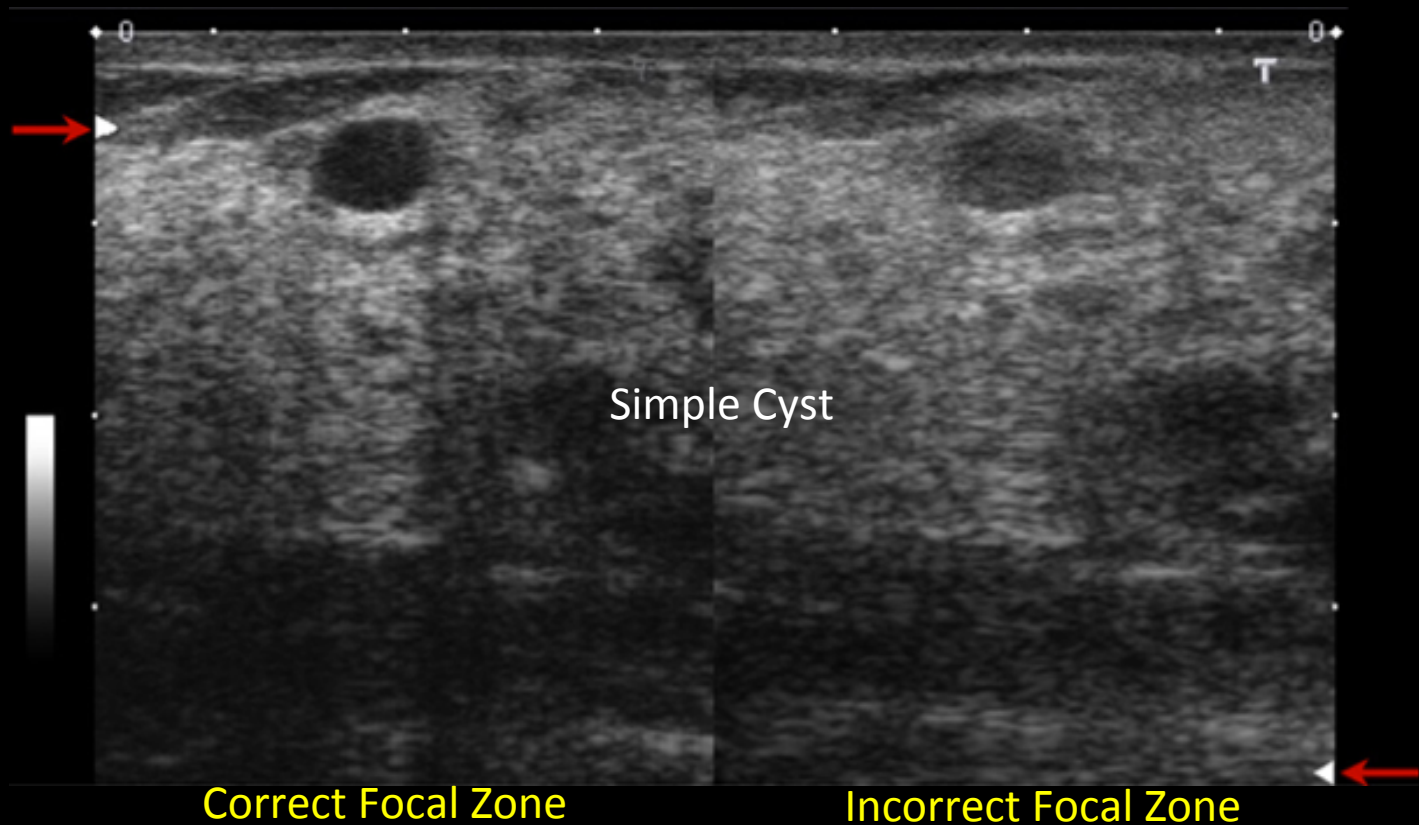
Basic Breast US Protocols

- Check:
 - Field of View
 - Don't include much of the lungs!
 - Focal Zone
 - Gain (incl TGC)
 - Use Colour or Power Doppler
 - Use PULSE WAVE DOPPLER (spectral waveform)
 - To confirm TRUE flow if you get (+) doppler signal



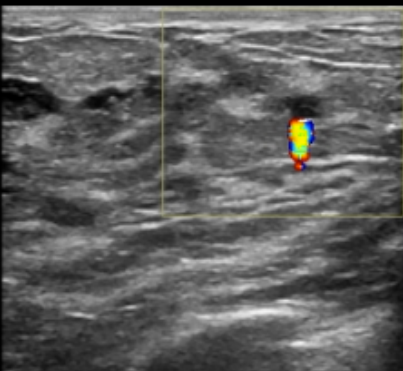
Basic Breast US Protocols

- Check:
 - Focal Zone

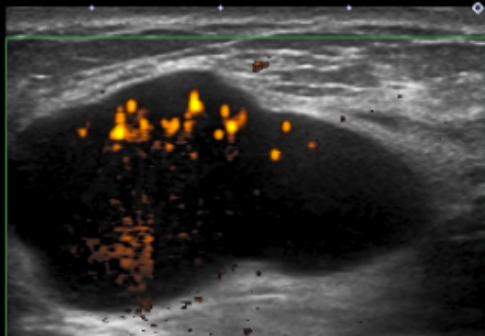


Basic Breast US Protocols

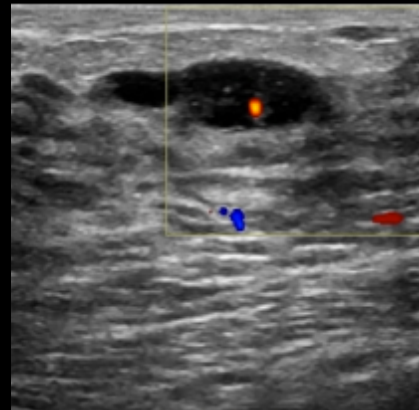
- Check:
 - Use Colour or Power Doppler
 - Use PULSE WAVE DOPPLER (spectral waveform)
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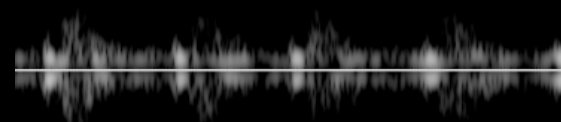
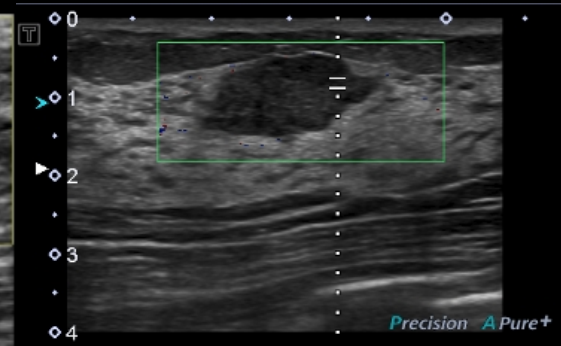
Twinkling
Artifact of
Milk of Calcium
Cyst



Doppler Artifact
From Intracystic
Mobile Debris



Artifact in
Cyst Septation vs.
True Vascular
Septation???



True Arterial Vascularity in
Intraductal Papilloma

Background Echotexture

- Tissue Composition

- Homogeneous

- Uniform hypoechoic fat lobules with echogenic Cooper's ligaments OR
 - Uniform echogenic fibroglandular tissue underlying thin subcutaneous fat

- Heterogeneous

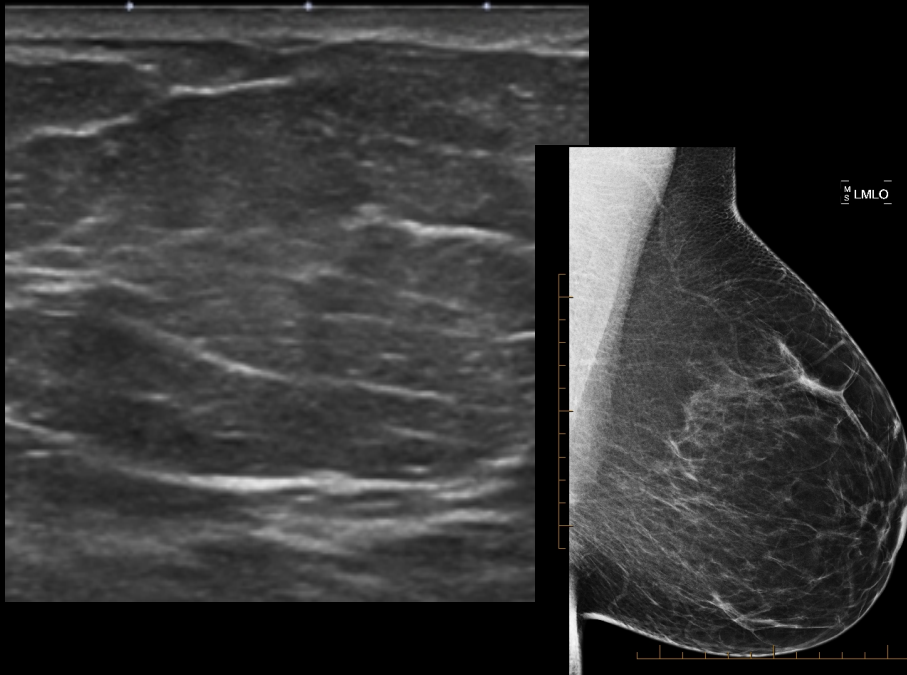
- Focally or Diffusely variable in echotexture, with many areas of increased/decreased echogenicity

Background Echotexture

Homogeneous

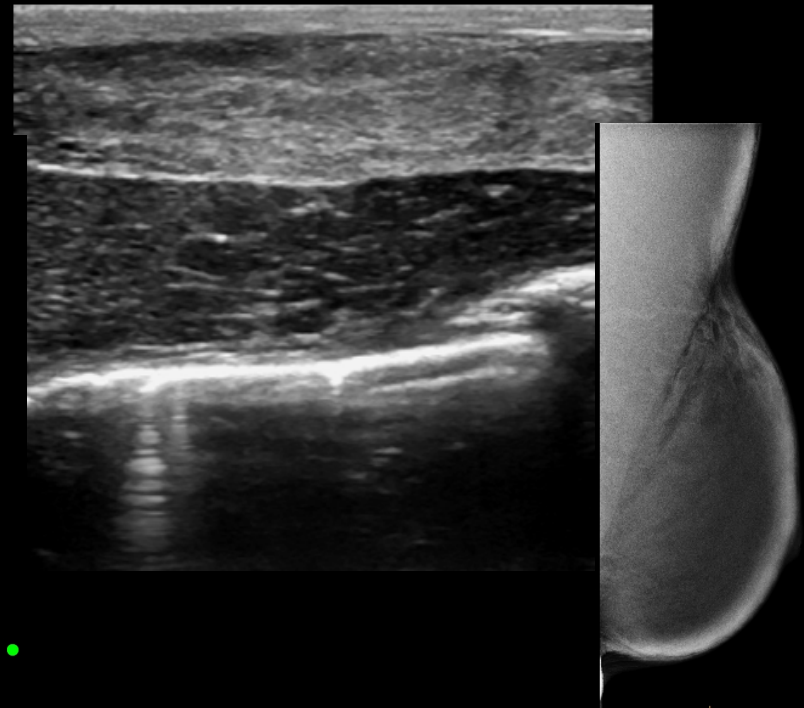
— Fatty

- Uniform hypoechoic fat lobules with echogenic Cooper's ligaments



— Fibroglandular

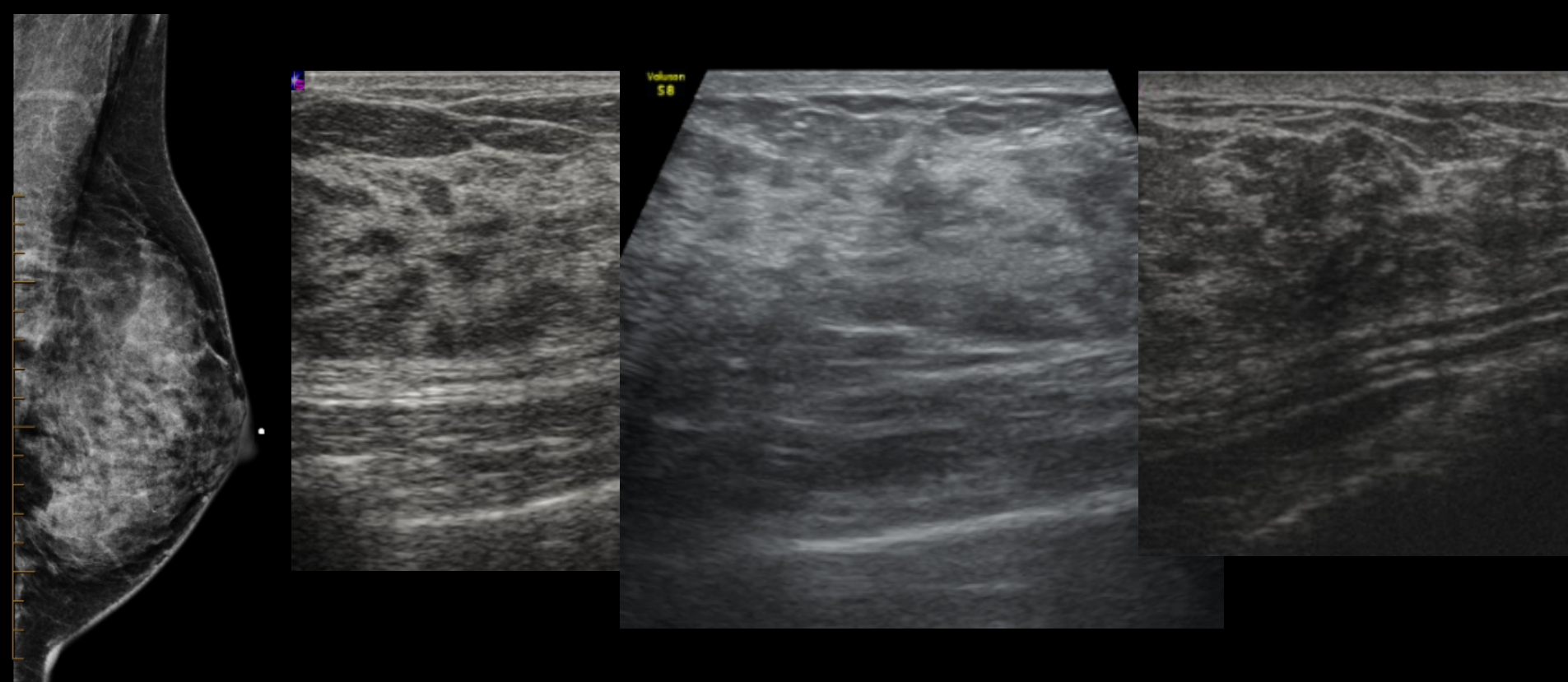
- Uniform echogenic fibroglandular tissue underlying thin subcutaneous fat



Background Echotexture

Heterogeneous

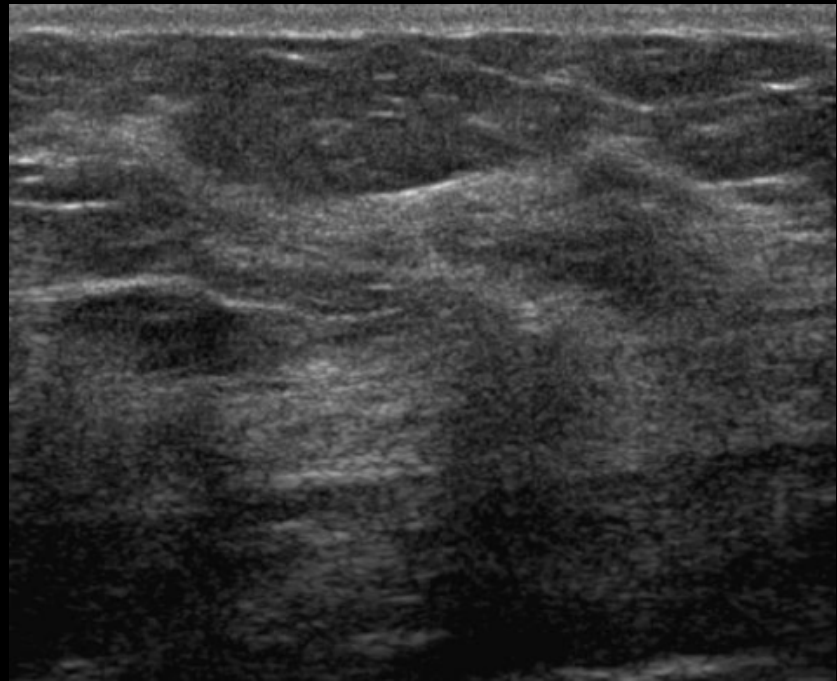
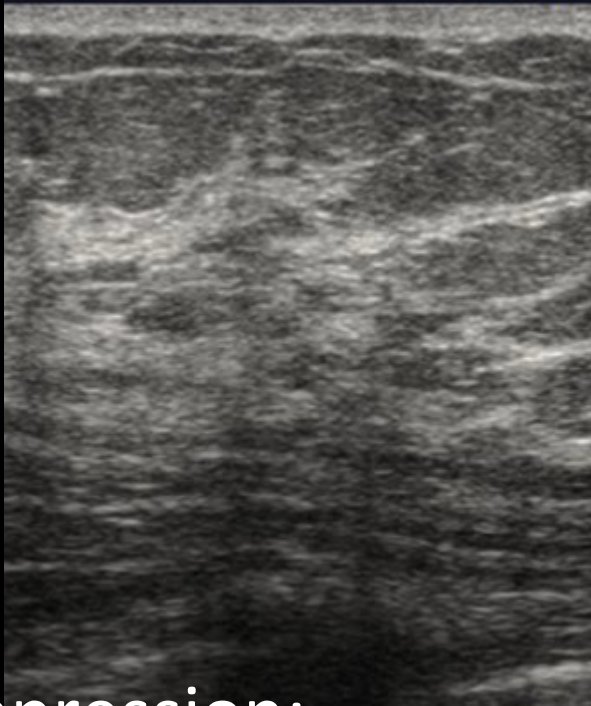
- **Focally** or **Diffusely** variable in echotexture, with many areas of increased/decreased echogenicity
- **Decreased Sensitivity?**



Heterogeneous Background Echotexture

Decreased Sensitivity?

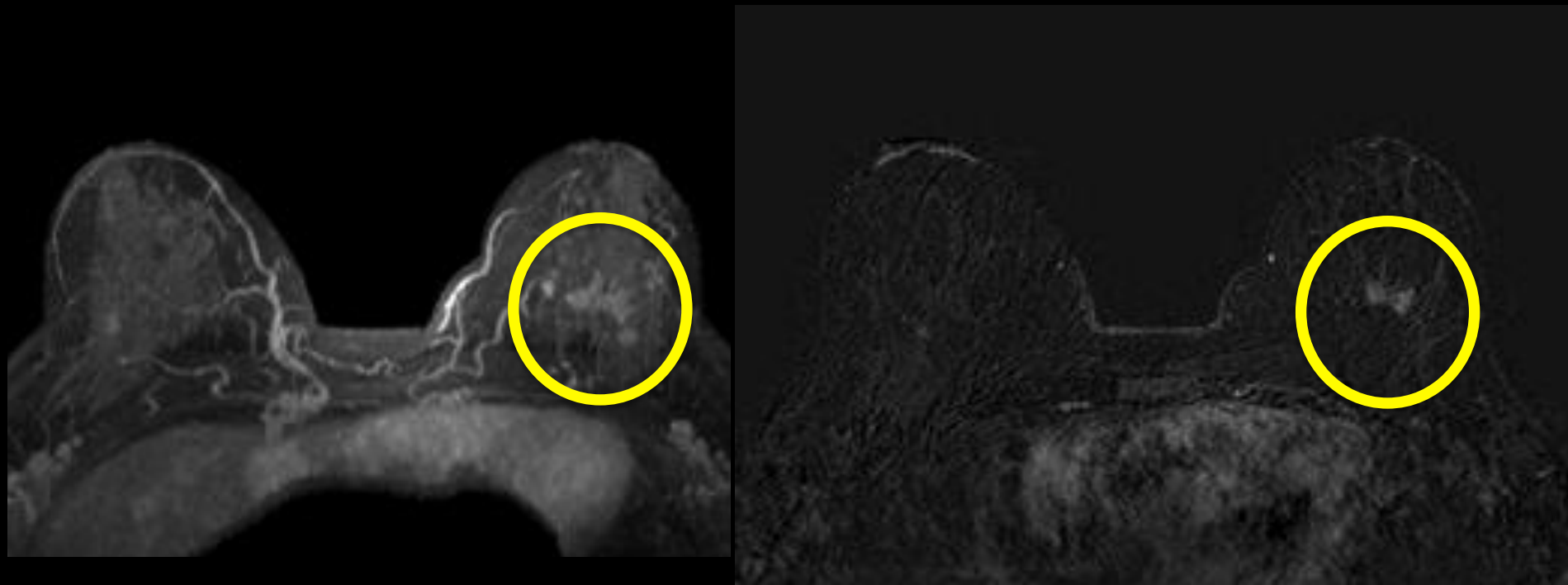
*Case eg. Palpable left upper breast lump,
Initial mammogram negative*



Impression:

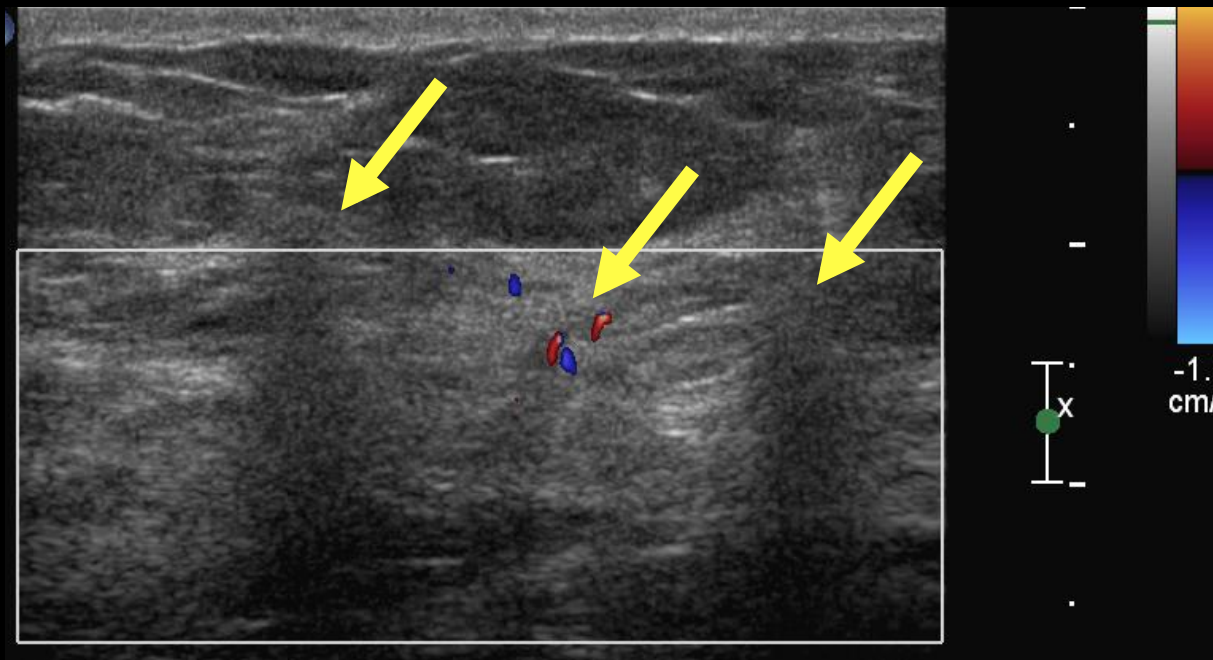
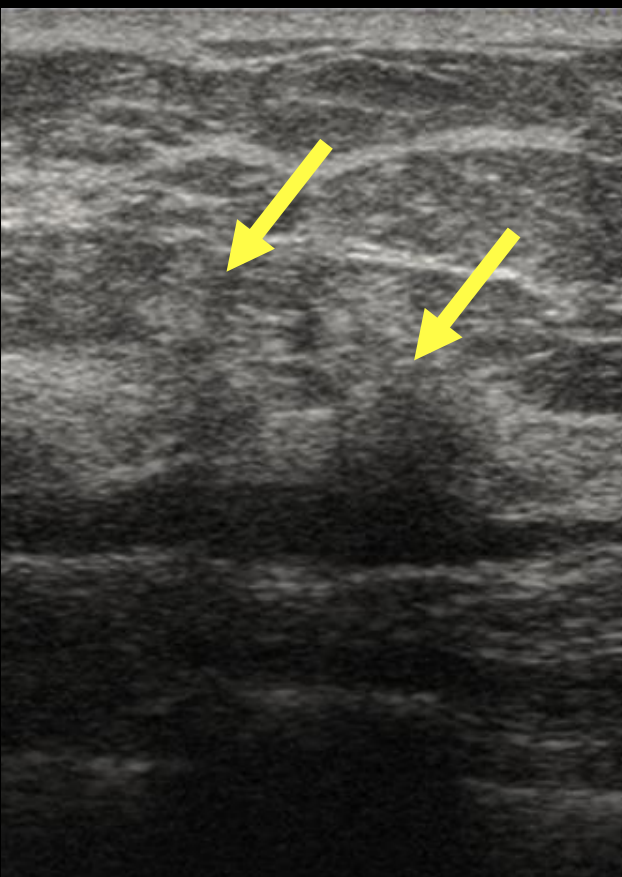
“No definite evidence of a mass or suspicious sonographic abnormality.”

Associated MRI



*Large area (3.5 cm) of Left upper breast
Asymmetric, Regional, Clumped NME with washout*

Second Look Ultrasound



Infiltrating ductal carcinoma with lobular features

Q2. Could this be cancer?

Feature	Benign	Malignant
Shape	Round, wider than tall	Taller than wide
Margins	Smooth	Irregular, angular, spicular
Lobulations	None or up to 3	Multiple
Capsule	Encapsulated	No capsule
Halo	Absent	Echogenic halo
Fixity	None	Fixed to surrounding tissue and/or underlying muscles
Shadowing or enhancement	Enhancement, edge shadowing	Shadowing behind lesion
Substance echogenicity	Anechoic (cystic), Hyperechoic	Hypoechoic, calcification

- Go by **Single** most suspicious finding

Q2. Could this be cancer?

- Go by **Single** most suspicious finding
 - Only 1/3 of cancers shadow
 - That means 2/3 cancers have normal or enhanced transmission!
 - The larger a cancer gets, the LESS likely it will be taller-than-wide
 - Sometimes cancers can be VERY SUBTLE
 - can mimic fibroadenomas, cysts, even heterogeneous normal tissue
 - Subtle shadowing
 - Microlobulated, angular margins

Lesions on Ultrasound

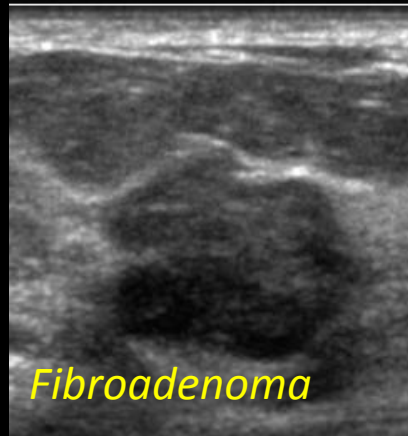
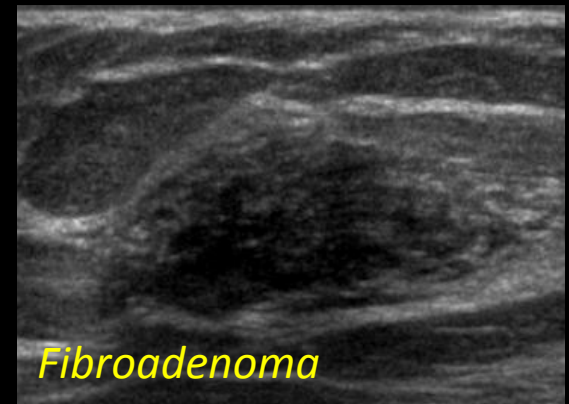
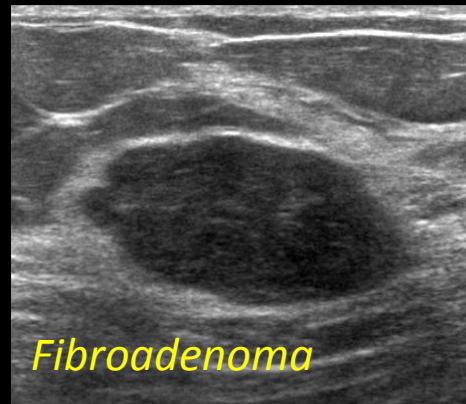
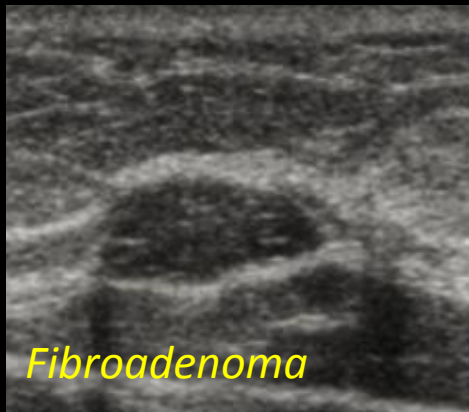
- **The “Big 3”: SHAPE, MARGINS, ORIENTATION**
- Echogenicity, Shadowing, Calcifications, Architectural distortion, Vascularity, Axillary lymphadenopathy
- Go by **Single** most suspicious finding
- **Increased # of suspicious features? → more likely cancer**
 - Eg. Irregular shape, non-circumscribed margins (eg. spiculated), taller-than-wide orientation, echogenic halo, posterior acoustic shadowing

Masses

- **SHAPE**
 - Oval (now includes macrolobulated)
 - Round
 - Irregular
- **MARGINS**
 - **Circumscribed** vs.
 - **Non-circumscribed** (*everything else; more suspicious*)
 - Indistinct, Microlobulated, Angular, Spiculated
 - Includes Echogenic Rim/Halo* (i.e. lesion-tissue interface)
- **ORIENTATION**
 - Parallel to skin (*“wider-than-tall”; 23% malignant*)
 - Anti-parallal (*“taller-than-wide”; more suspicious, 70% malig*)

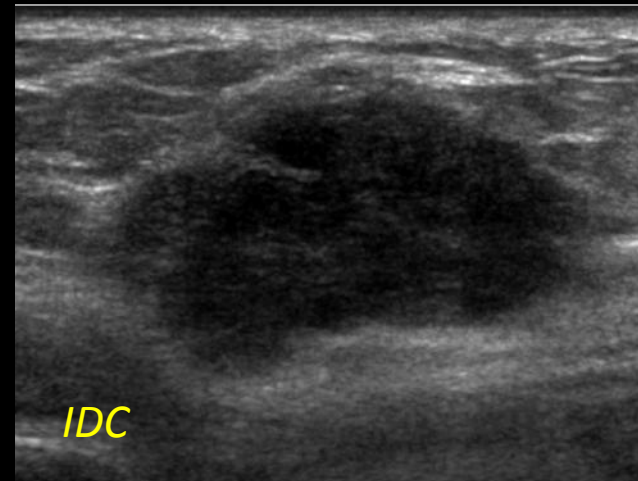
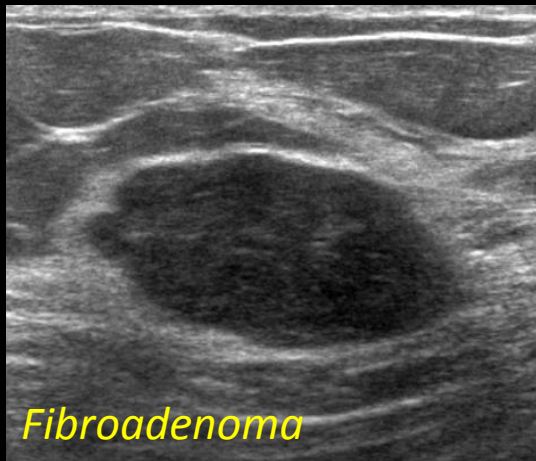
Shape - Oval

- Egg-shaped, elliptical
- *more likely benign* (85% benign; bx if new, growing/change)
 - *includes macrolobulated (2-3 gentle lobulations)*



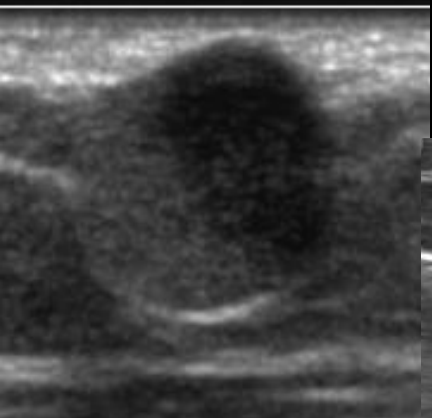
Macrolobulated vs. Microlobulated

- *Macrolobulated, a subset of OVAL SHAPE*
- *2-3 gentle lobulations*
- *less useful descriptor than OVAL shape, CIRCUMSCRIBED margin, and more easily confused with microlobulated*
- *Microlobulated, type of NON-CIRCUMSCRIBED MARGIN*
- *1-2 mm, more numerous, closer together*

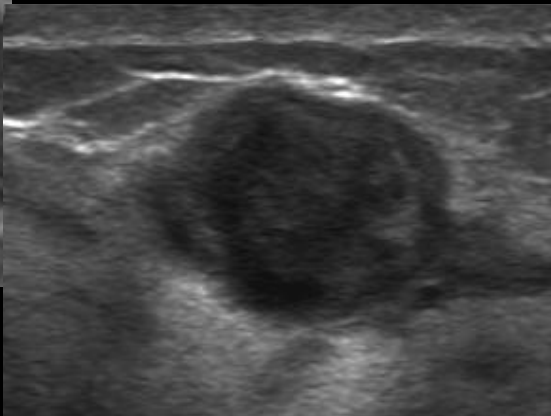


Shape - Round

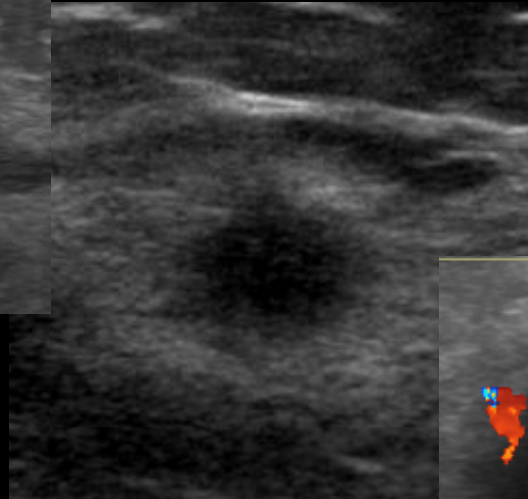
- *More suspicious than oval*



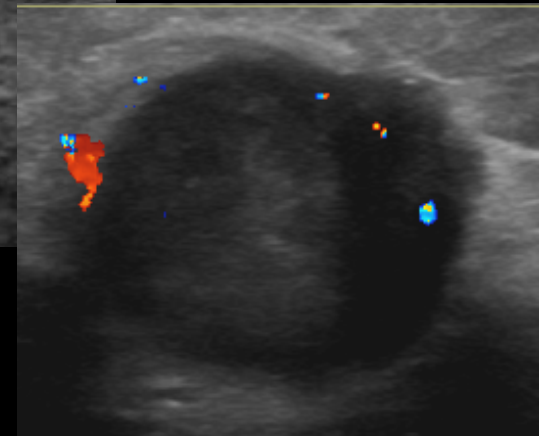
*Sebaceous Cyst with
Fat-Fluid Level*



Intraductal Papilloma



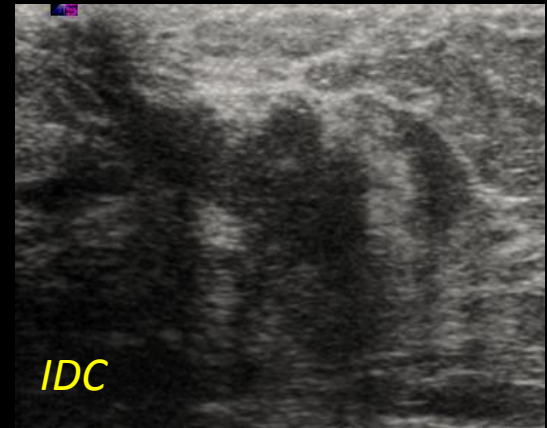
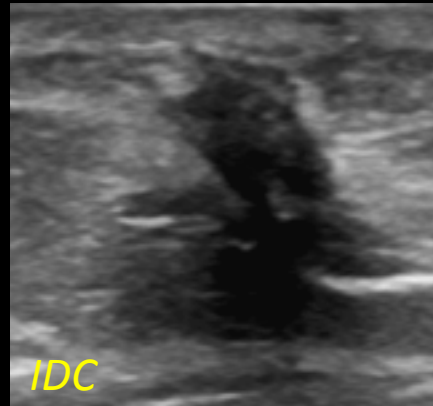
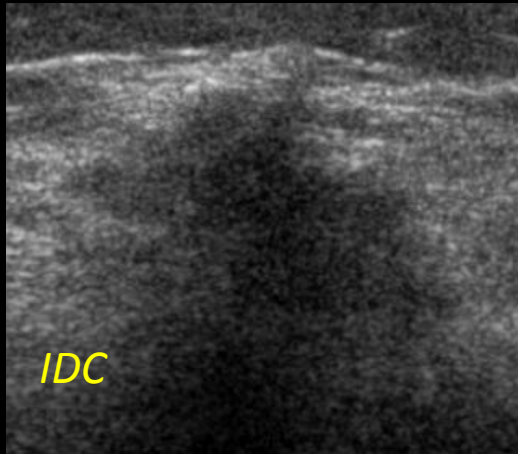
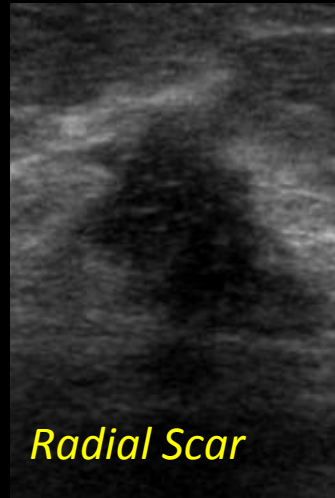
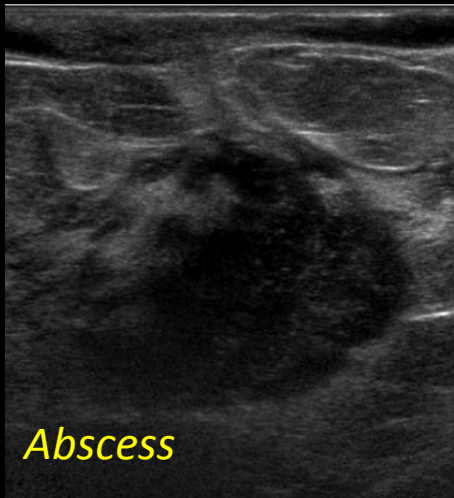
IDC NOS



IDC with osteoclast-like giant cells

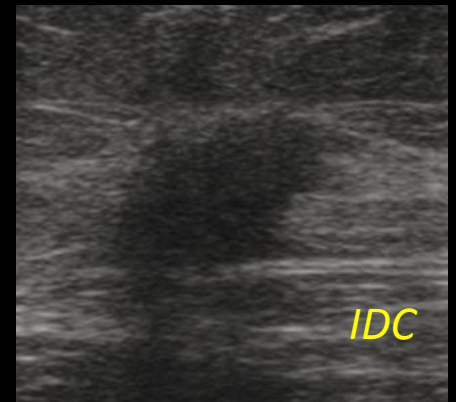
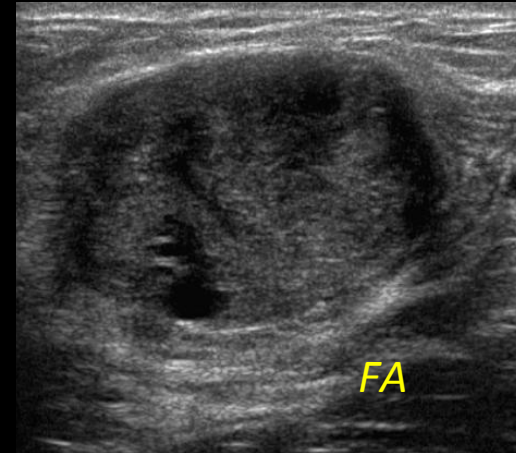
Shape - Irregular

- *Most suspicious shape* (60% malignant), neither oval or round



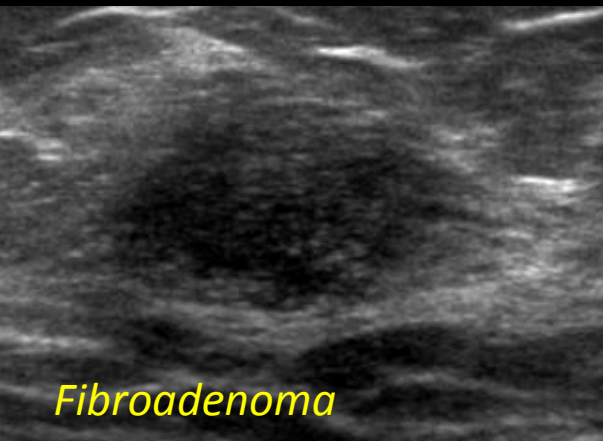
Margins

- Circumscribed
 - *more likely benign* (10% malignant)
- Non-circumscribed
 - *more suspicious*
 - Indistinct (45% malig)
 - Microlobulated (50% malig)
 - Angular (60% malig)
 - **Spiculated** (85% malig)
 - **Echogenic halo/rim** (70% malig)
 - eg. in cancer, abscesses, fat necrosis
 - No sharp demarcation between mass & surrounding tissue

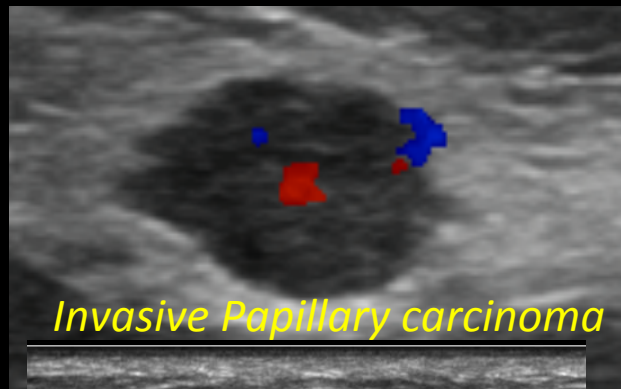


Non-Circumscribed Margins

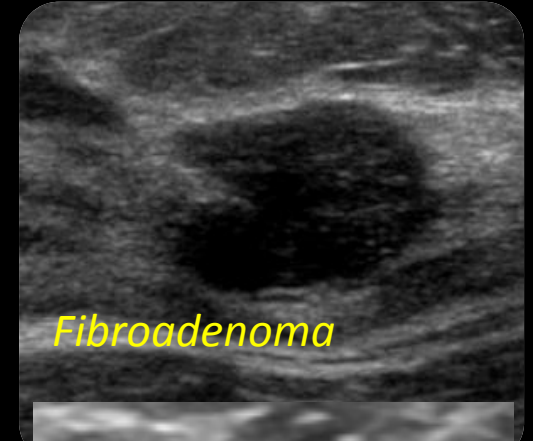
Indistinct



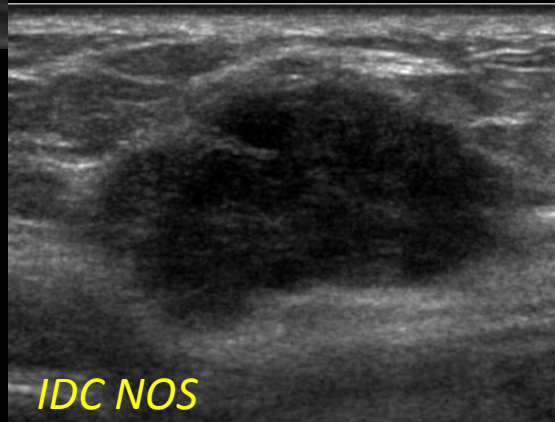
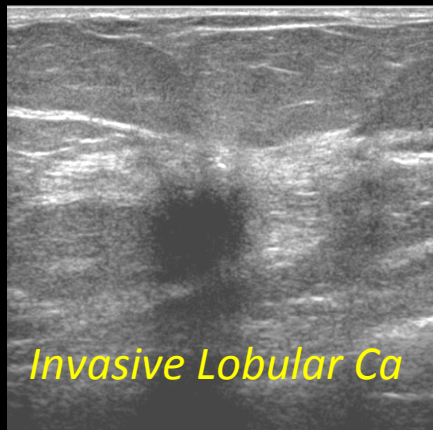
Microlobulated



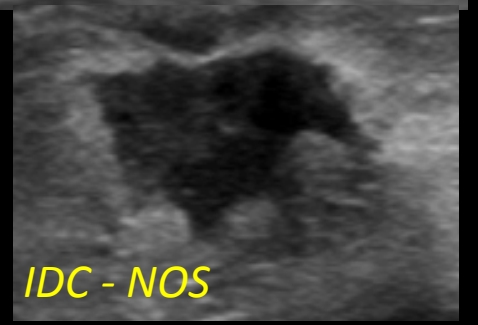
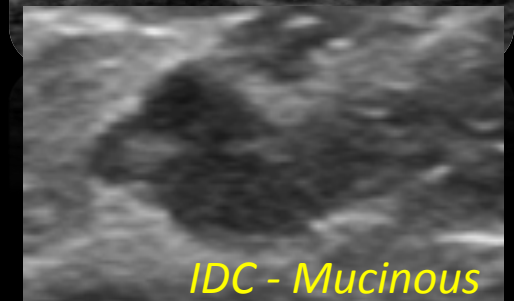
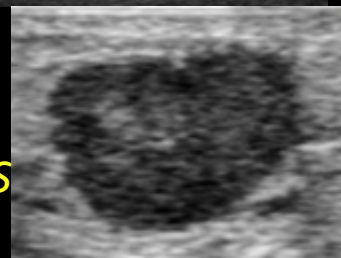
Angular



Spiculated

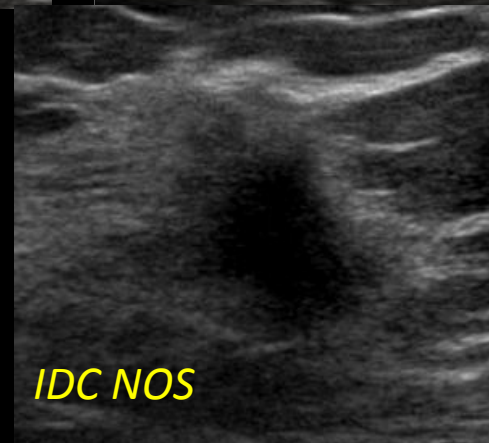
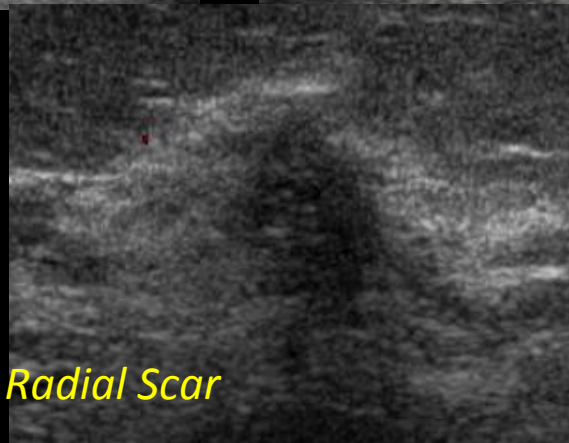
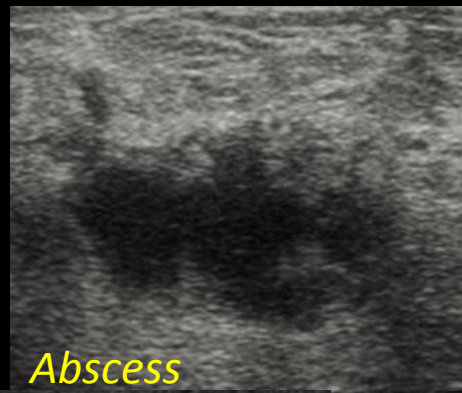


IDC NOS



Non-Circumscribed Margins

- Echogenic Rim/Halo (70% malig)
 - Infiltration; No sharp demarcation betw mass & surrounding tissue
 - *mention when considering Margins*



Orientation

Feature unique to Ultrasound

- Parallel to skin
(i.e. “wider-than-tall”)
 - *more likely benign*
(77% benign) growing along tissue planes
- Anti-parallel
(i.e. “taller-than-wide”)
 - *more suspicious*,
(70% malignant) growing against tissue planes

Fibroadenoma

Papilloma

Phyllodes

ILC

IDC NOS

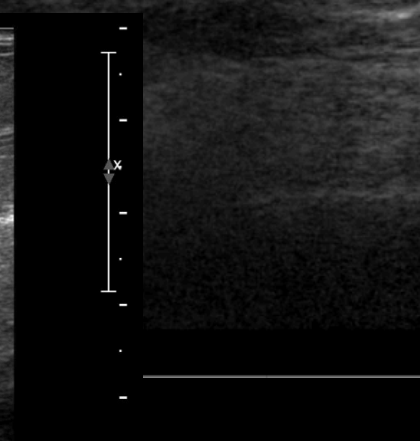
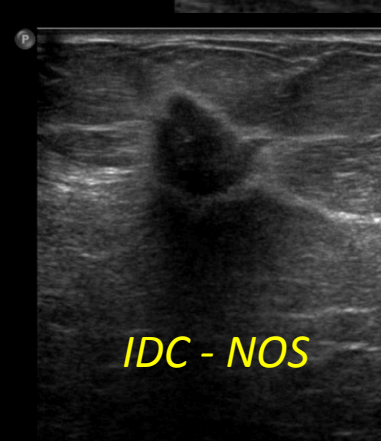
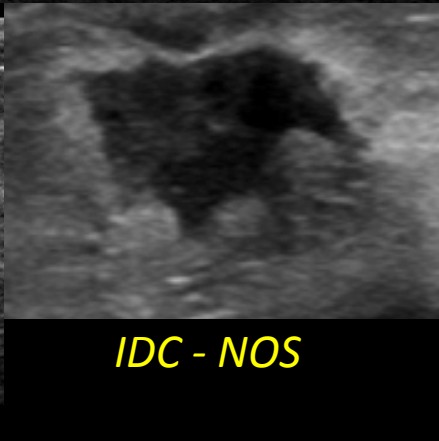
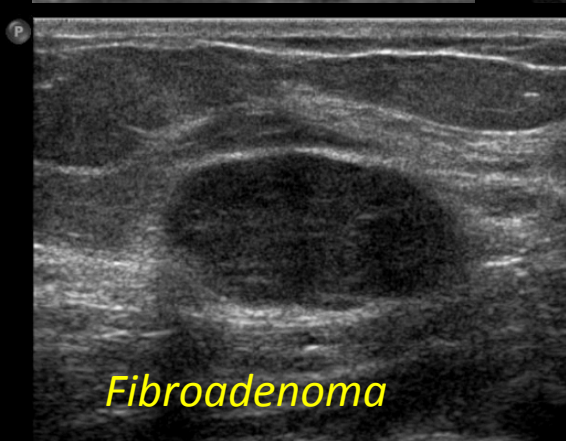
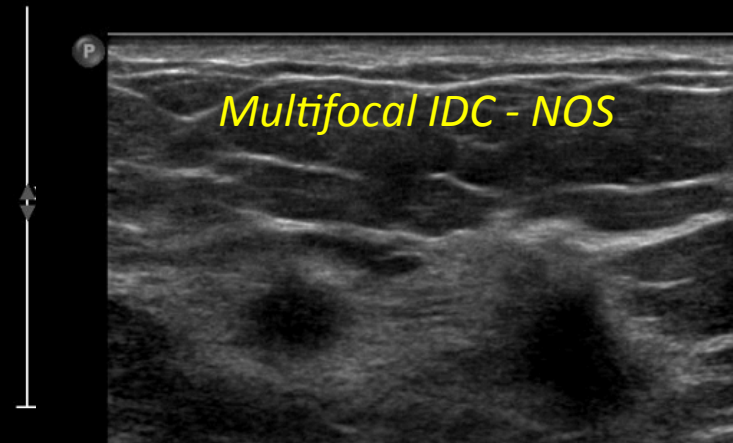
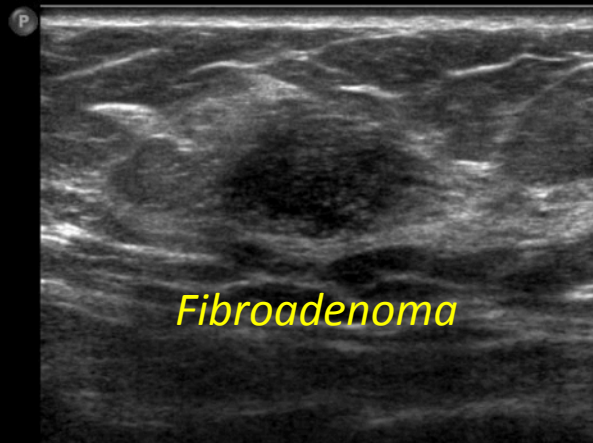
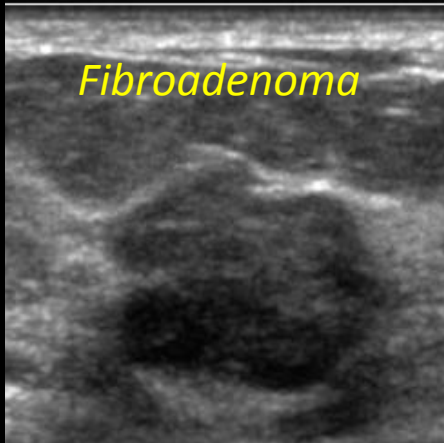
IDC NOS

Q3. “Have I shown the finding well enough?”

- Show margins well
 - circumscribed vs non-circumscribed
- Take an image without obscuring calipers first
 - esp for small lesions
- Cyst Fluid-debris levels
- Harmonics
 - can make solid lesions more hypoechoic, to stand out more

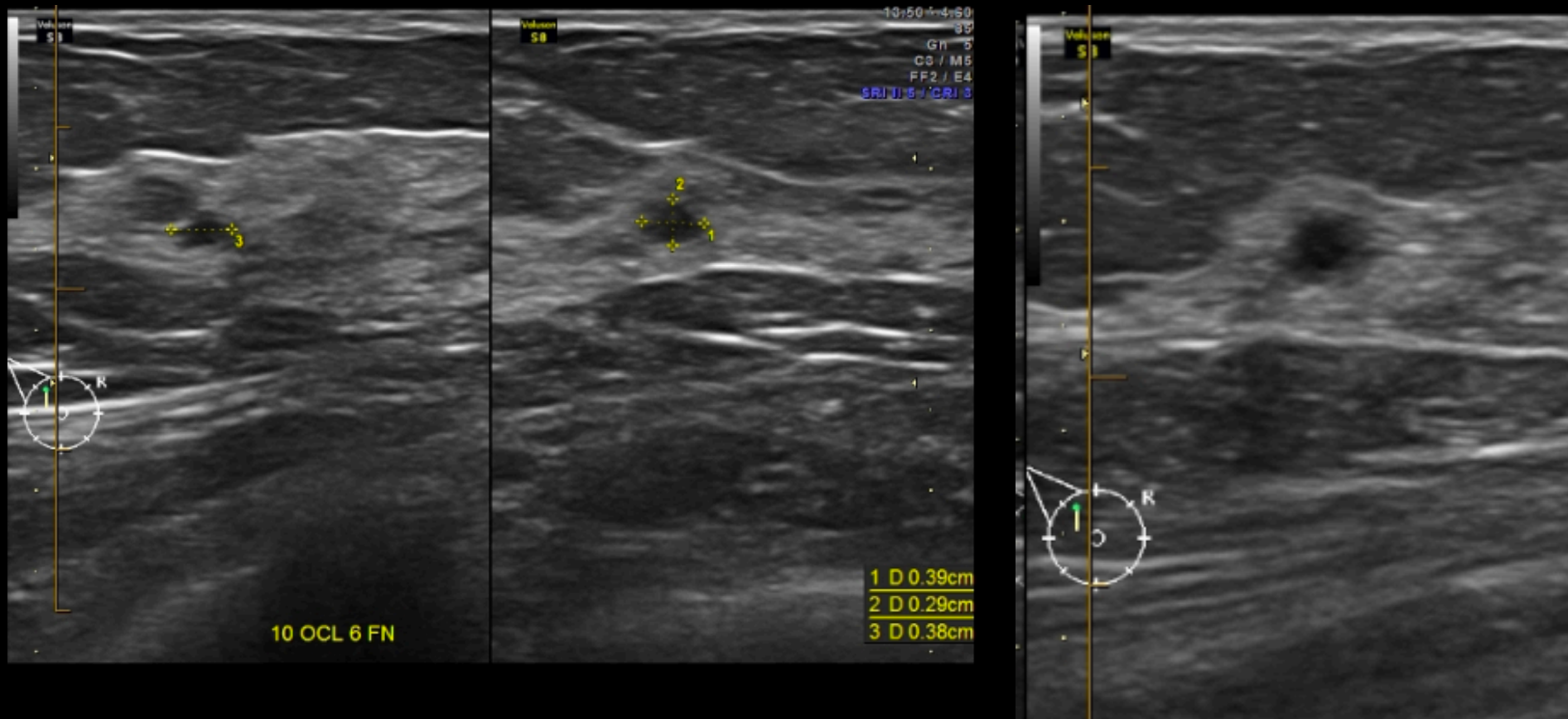
Q3. “Have I shown the finding well enough?”

- Show margins well
 - circumscribed vs non-circumscribed



Q3. “Have I shown the finding well enough?”

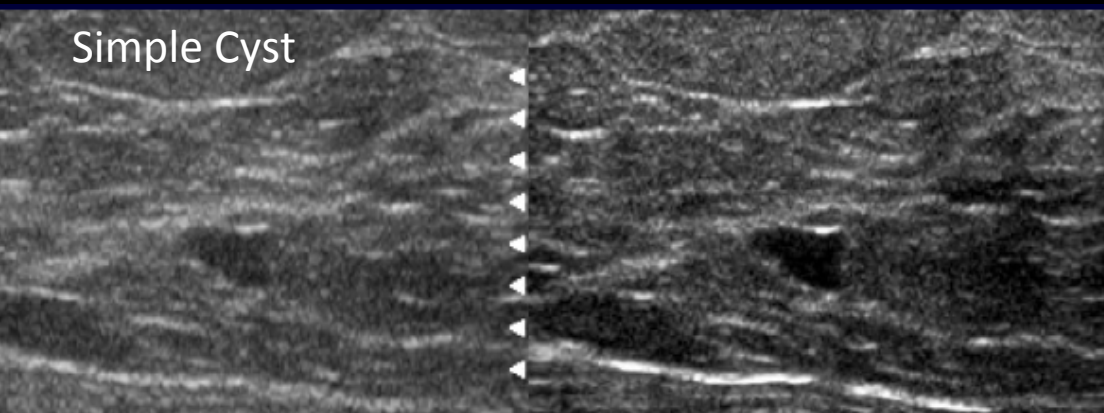
- Take an image without obscuring calipers first
 - esp for small lesions



Q3. “Have I shown the finding well enough?”

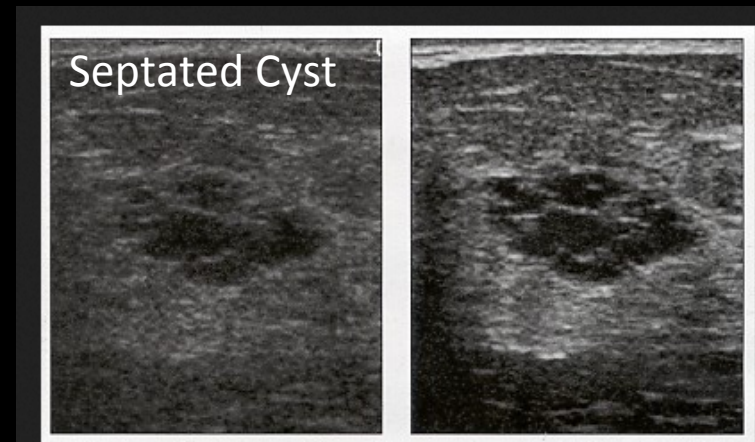
- Harmonics

- Increases conspicuity
- improves border definition & contrast
 - esp useful for subtle shadowing or isoechoic lesions
 - to “clean up” cysts



Without

With Harmonics



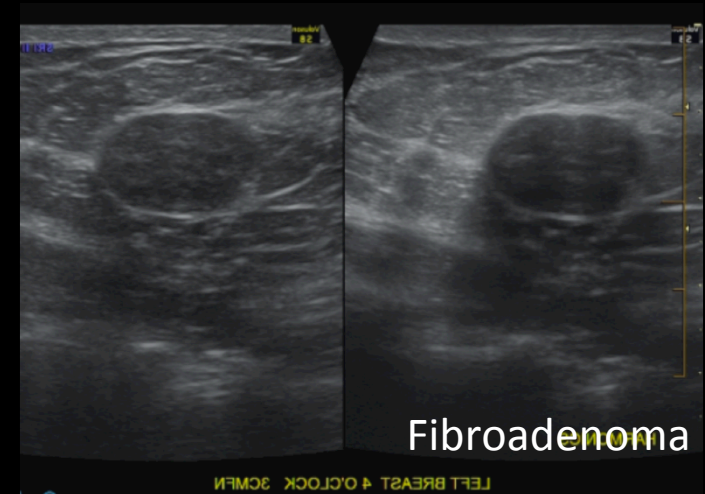
Without

With Harmonics

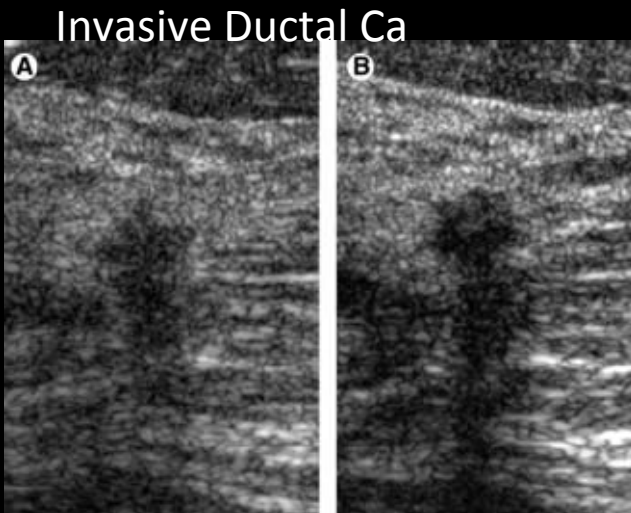
Q3. “Have I shown the finding well enough?”

- Harmonics

- Increases conspicuity
- improves border definition & contrast

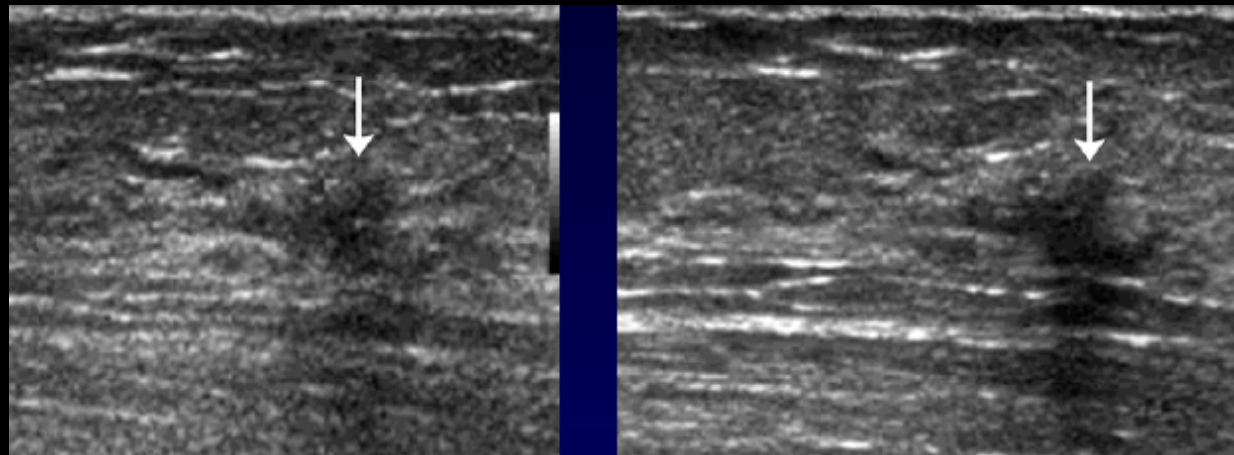


DCIS



Without

With Harmonics

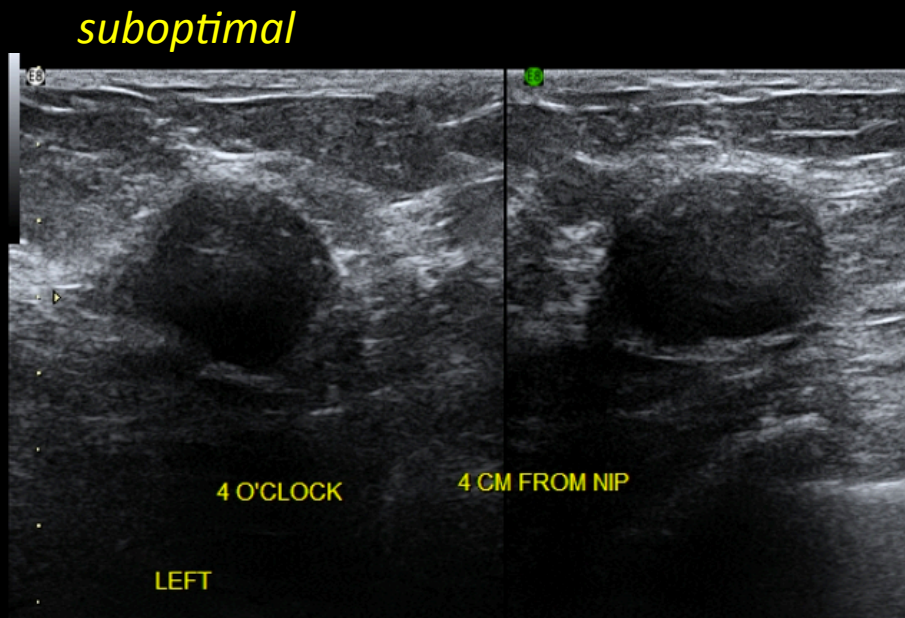


Without

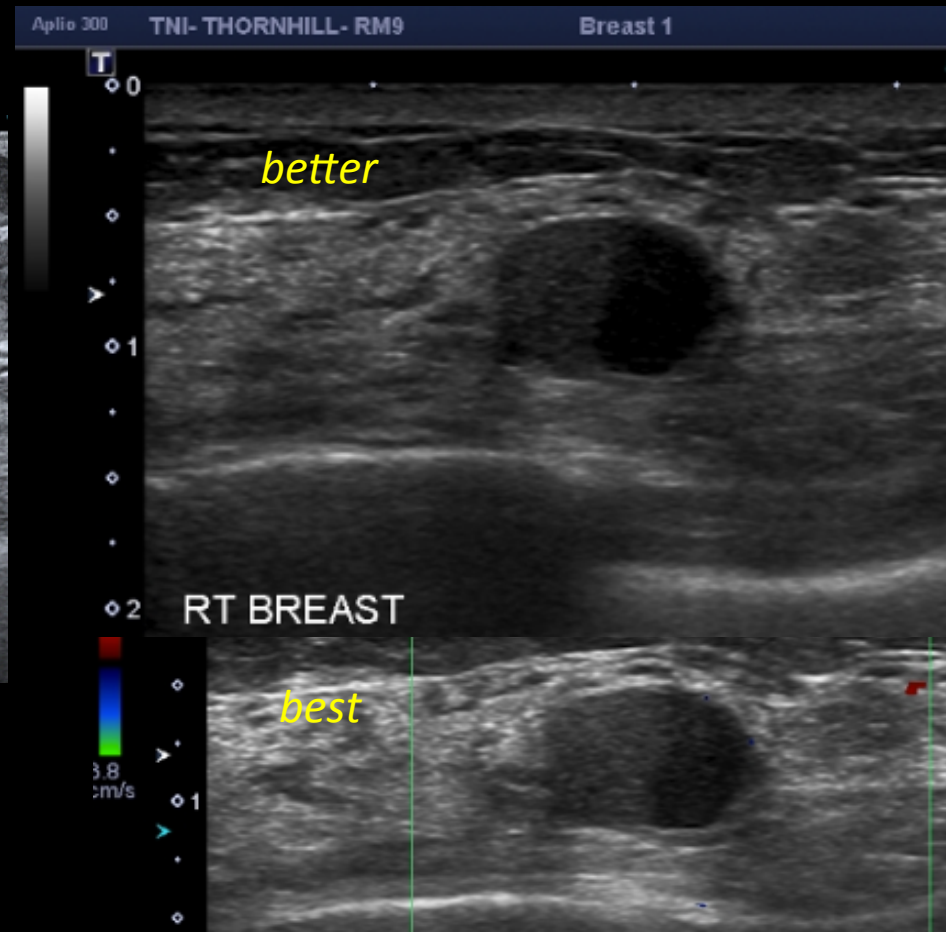
With Harmonics

Q3. “Have I shown the finding well enough?”

- Cyst Fluid-debris levels
 - Show the linear interface

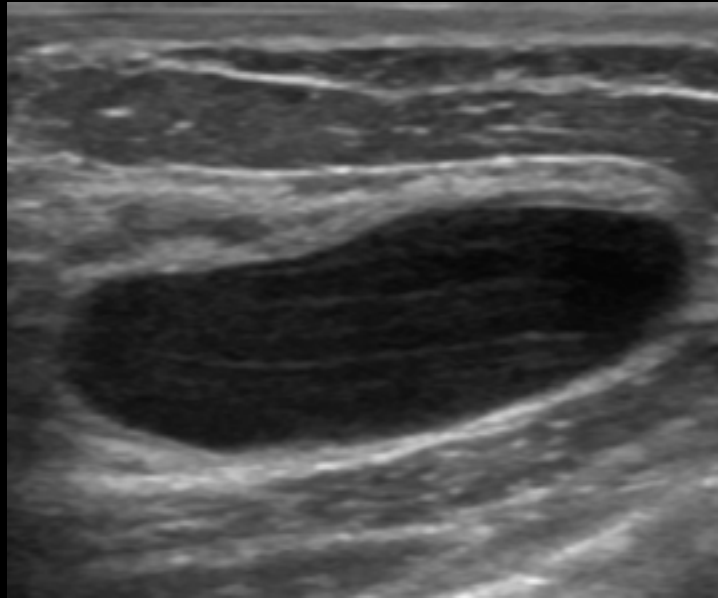


- change your Gain
- change your Focal depth
- Use Harmonics
- Use Doppler



Cysts, Cysts, & more Cysts....

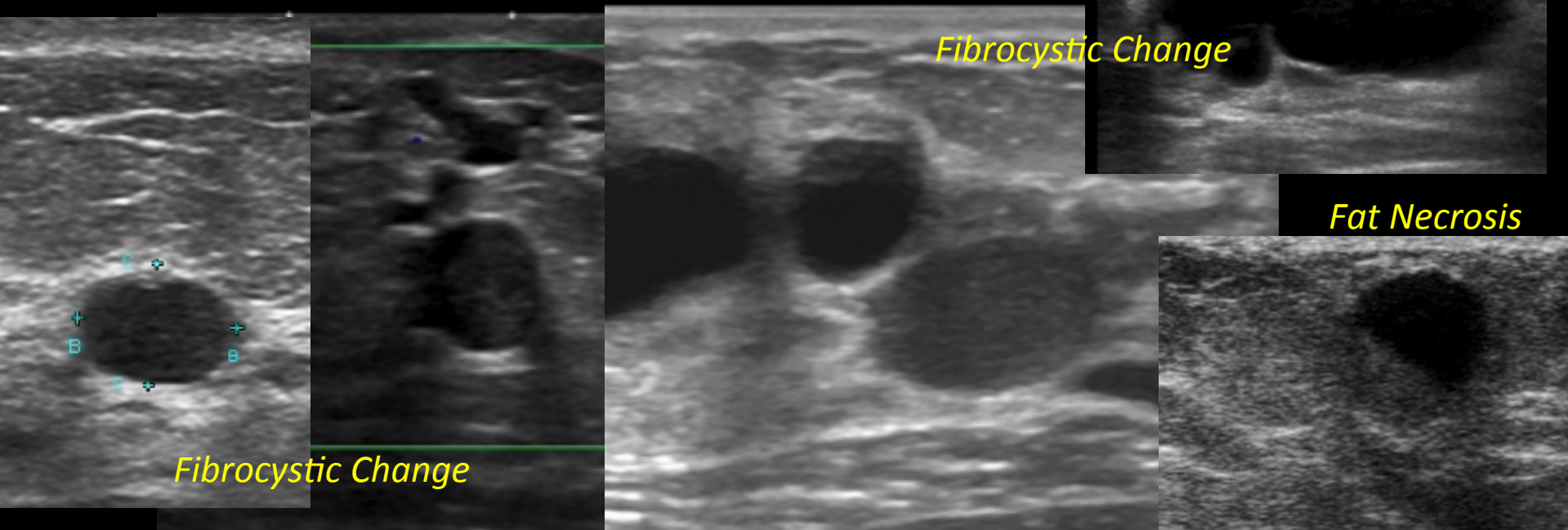
- Simple cyst = anechoic (BI-RADS2)



*Simple Cyst
Of FCC*

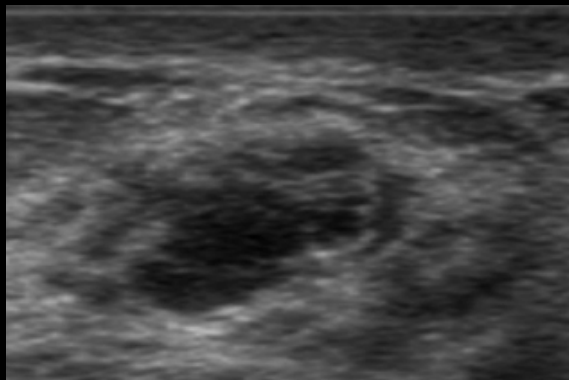
Cysts, Cysts, & more Cysts....

- **Complicated cyst** = Intracystic debris (BI-RADS2 or 3)
 - minimal low level echoes
 - fluid-debris levels
 - hypoechoic mimicking solid masses
 - cyst w/ thin septation

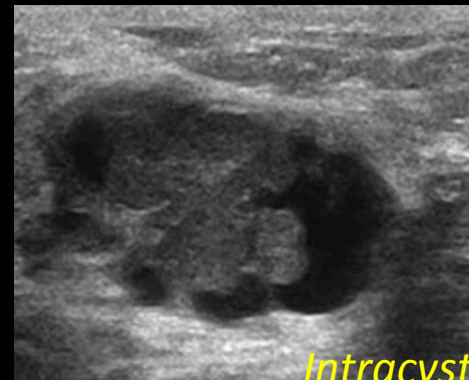
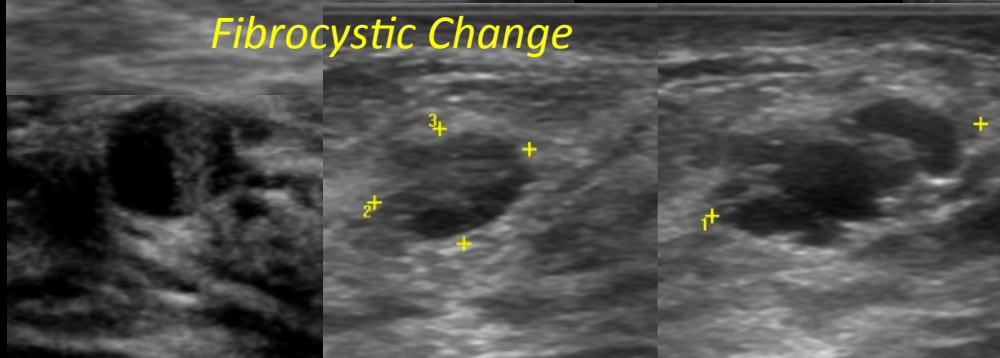


Cysts, Cysts, & more Cysts....

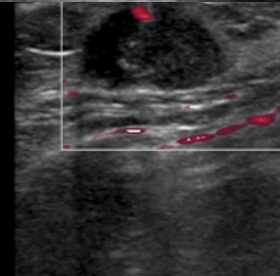
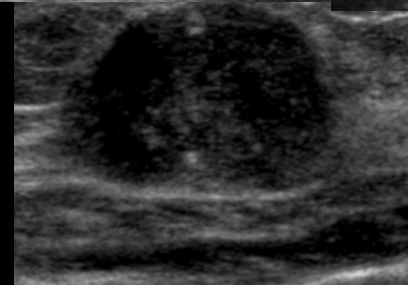
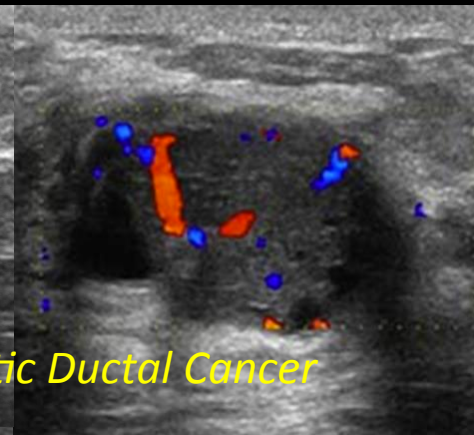
- **Complex cyst** (BI-RADS4, needs biopsy. Rarely BI-RADS3)
 - Solid, mural nodule
 - Thick septation
 - Use colour & PW doppler to document vascularity



Fibrocystic Change

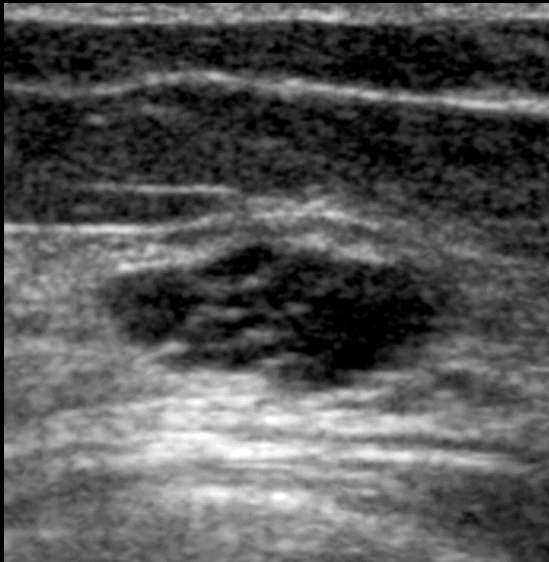


Intracystic Ductal Cancer

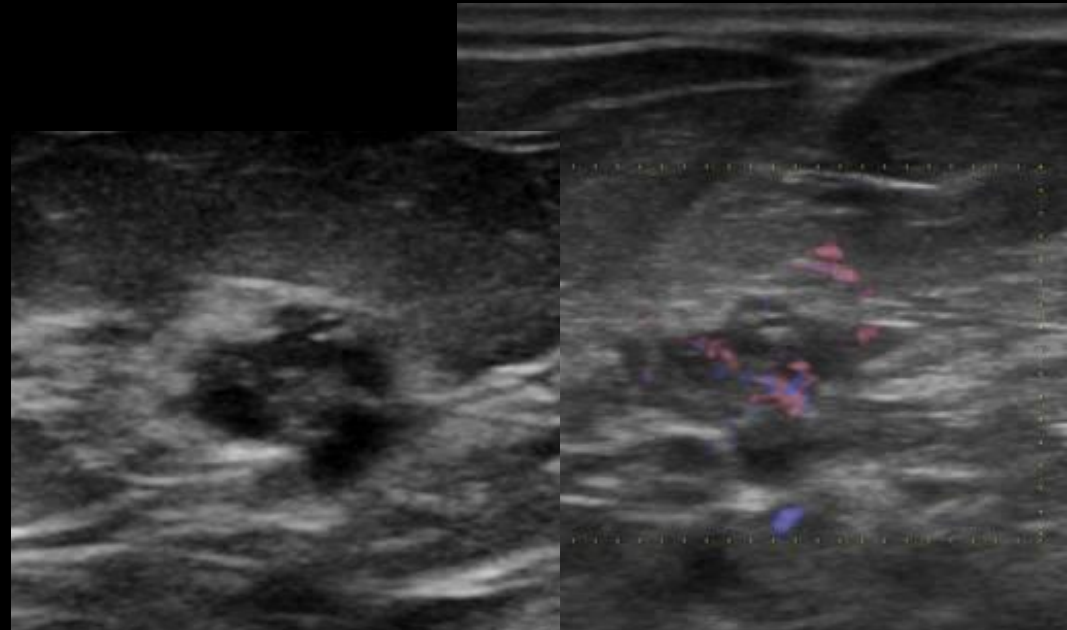


Cysts, Cysts, & more Cysts....

- Clustered microcysts
 - FCC vs. DCIS?
 - Turn on doppler!



Fibrocystic Change



DCIS

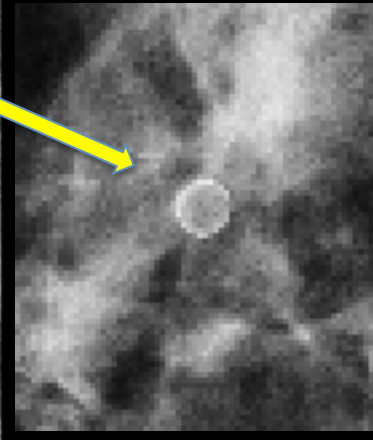
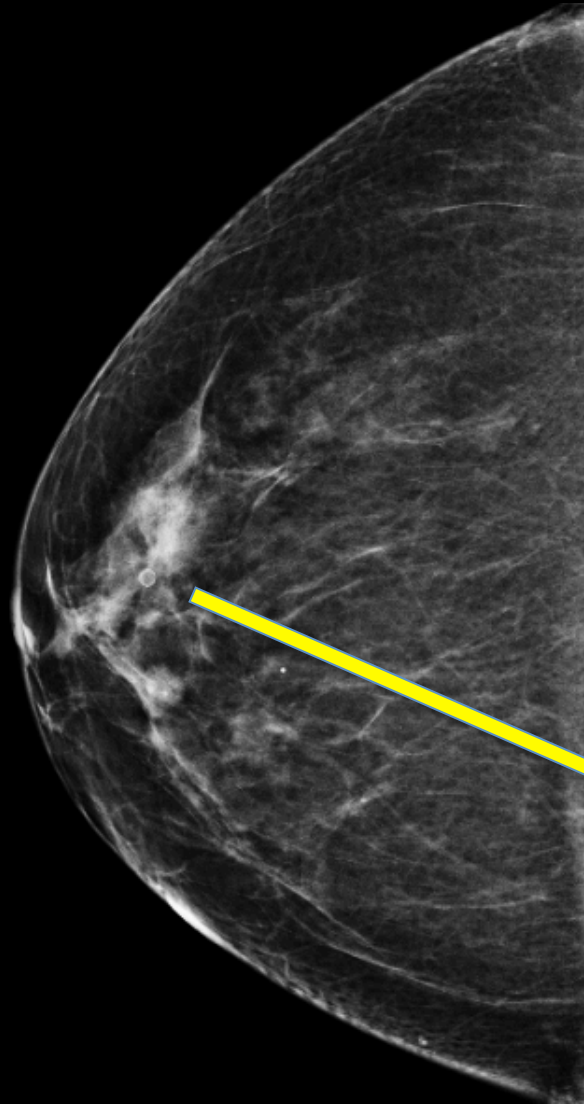
Cysts, Cysts, & more Cysts....

- **Benign Oil cysts**

- Shadowing
- Thin, echogenic rim

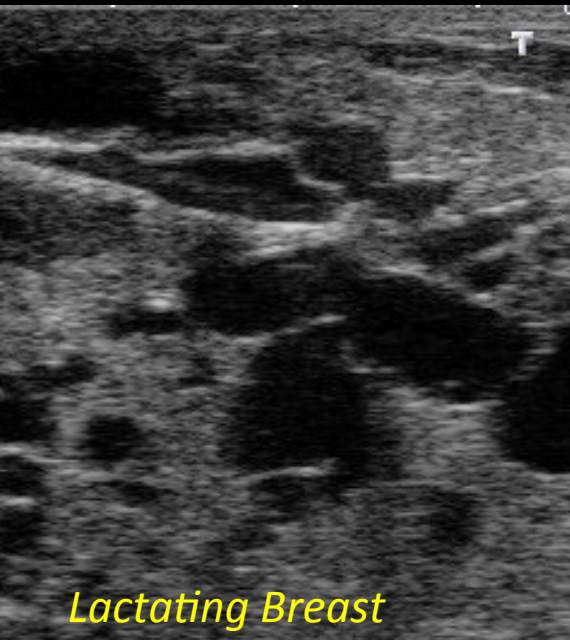


RCC

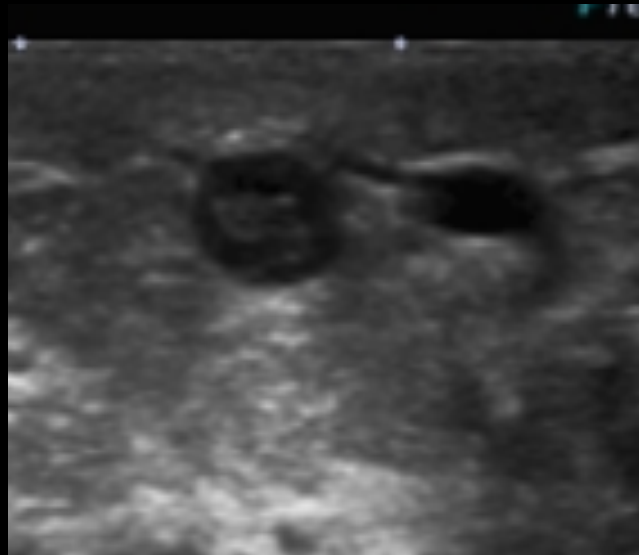


Dilated Ducts

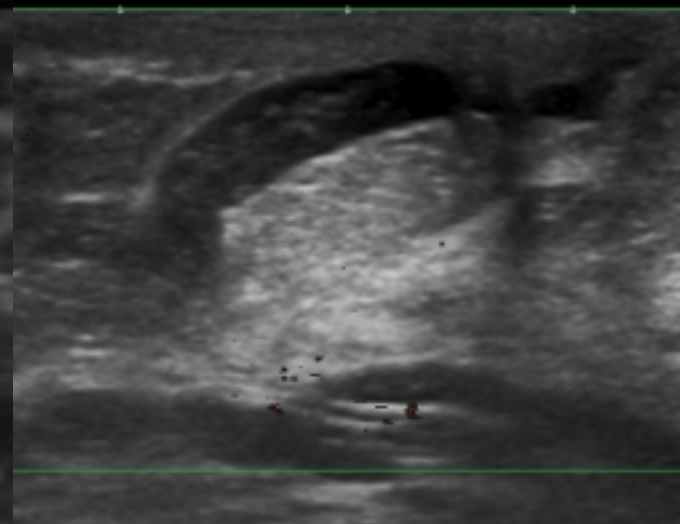
- Intraductal debris vs. papilloma vs. cancer?
 - Turn on doppler
 - Ballottment
 - Fluctuant material?



Lactating Breast

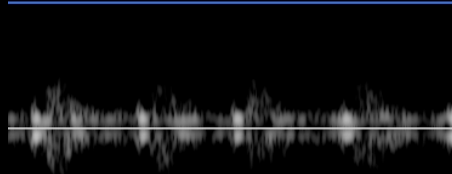
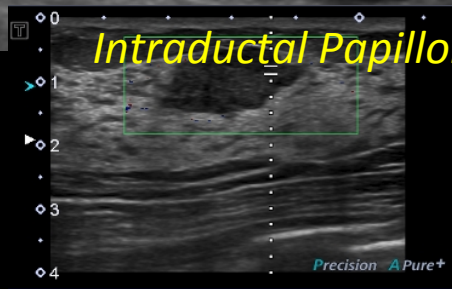


Intracystic debris or papilloma? (awaiting pathology)

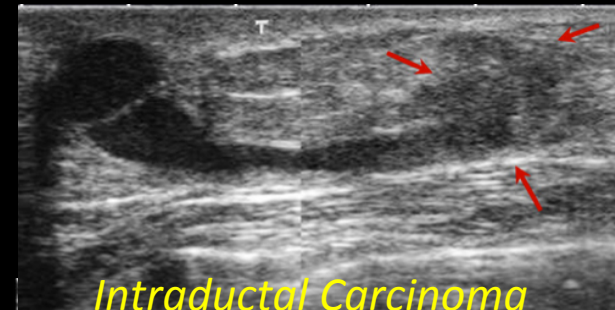
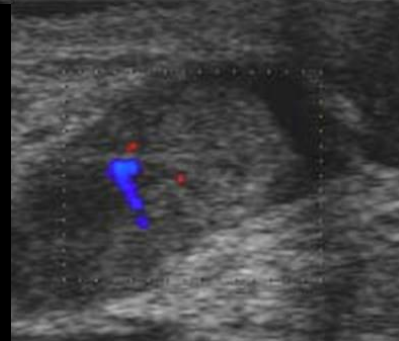


Dilated Ducts

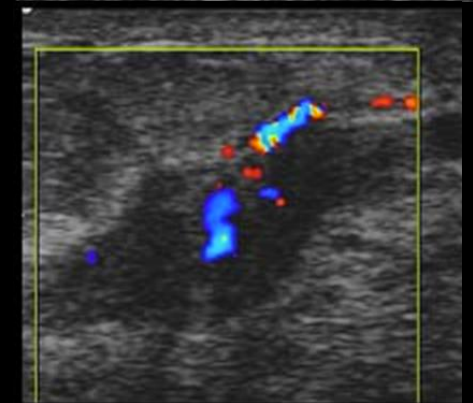
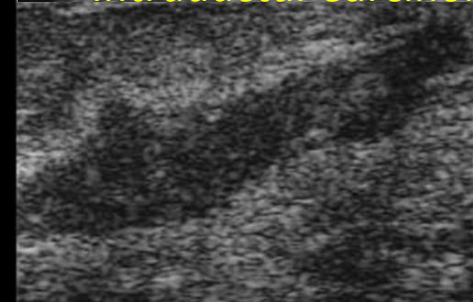
- Intraductal debris vs. papilloma vs. cancer?
 - Turn on doppler
 - Ballottment
 - Fluctuant?



Intraductal Papilloma



Intraductal Carcinoma



Ultrasound of Breast Implants

1. Breast Cancer Screening

– to complement mammography

- Mammo:

- 40% decreased visualization of breast parenchyma for subglandular implants
- 10% decreased visualization for retropectoral implants

2. Assess for Implant Rupture

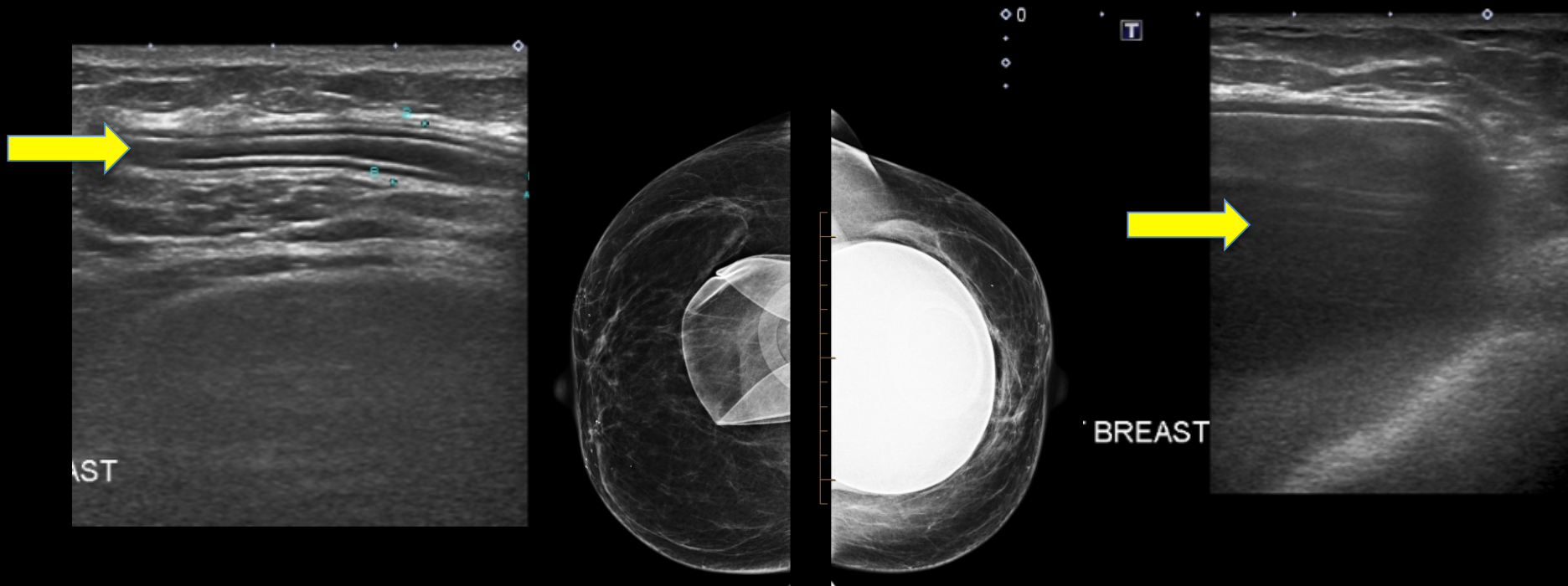
– US 59-85% sensitive and 55-84% specific

(+) low cost, no ionizing radiation

(-) but Lower sensitivity and specificity than MRI

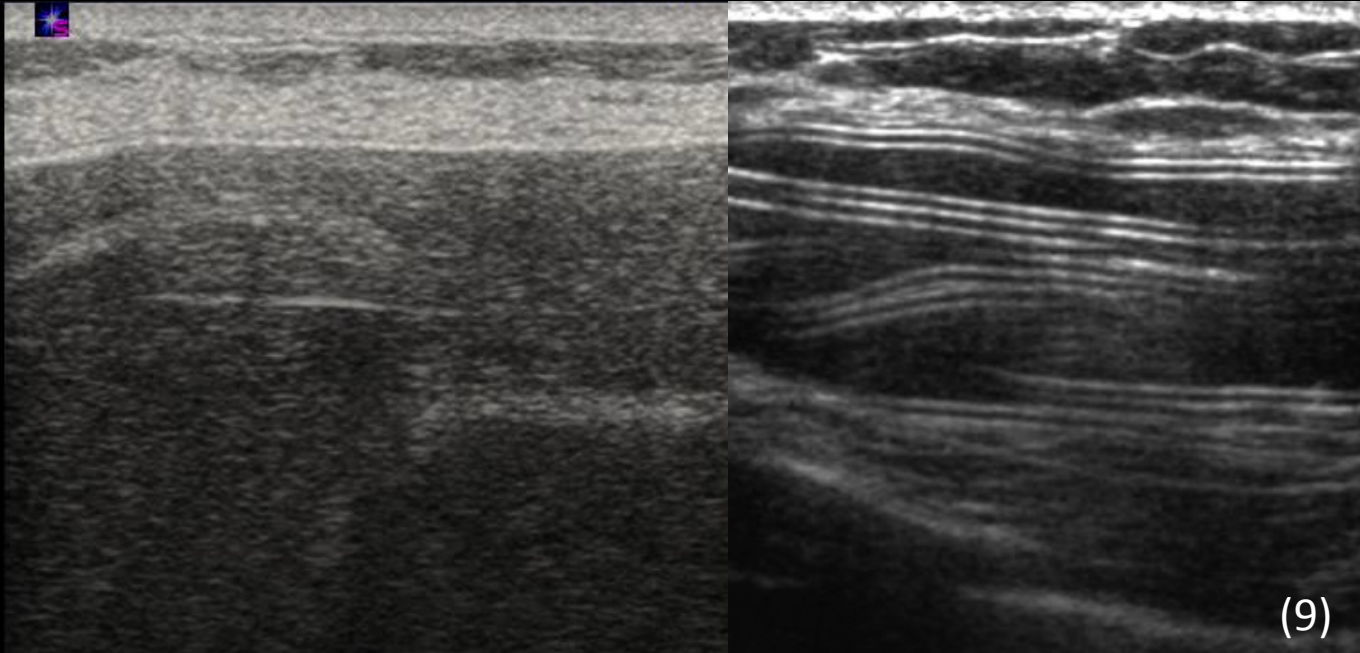
Saline Breast Implant Rupture

- Not a diagnostic dilemma
 - Clinically, on US, or on mammography



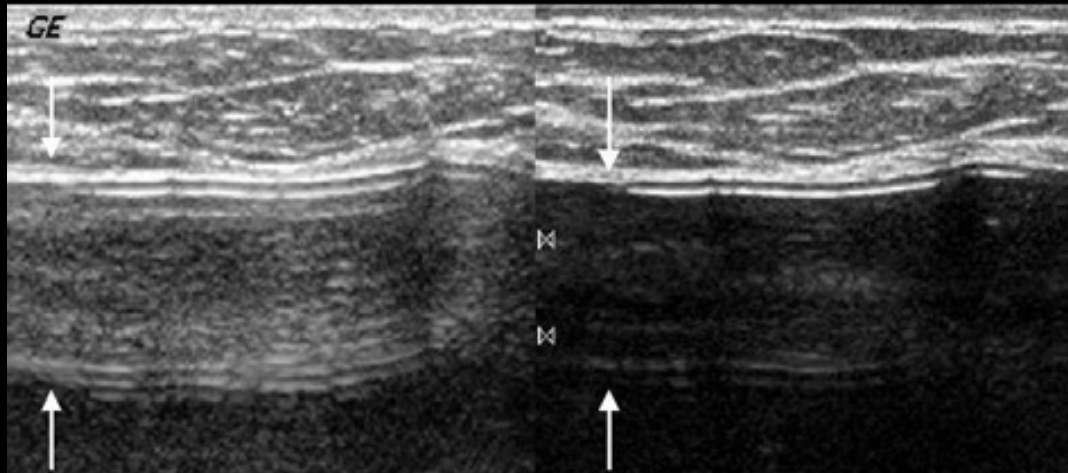
Silicone Implant Rupture - Ultrasound

- Definite Sign of Intracapsular Rupture
 - “Stepladder Sign”
 - Multiple lines traversing through implant at various levels
 - Silicone shell floating within the gel



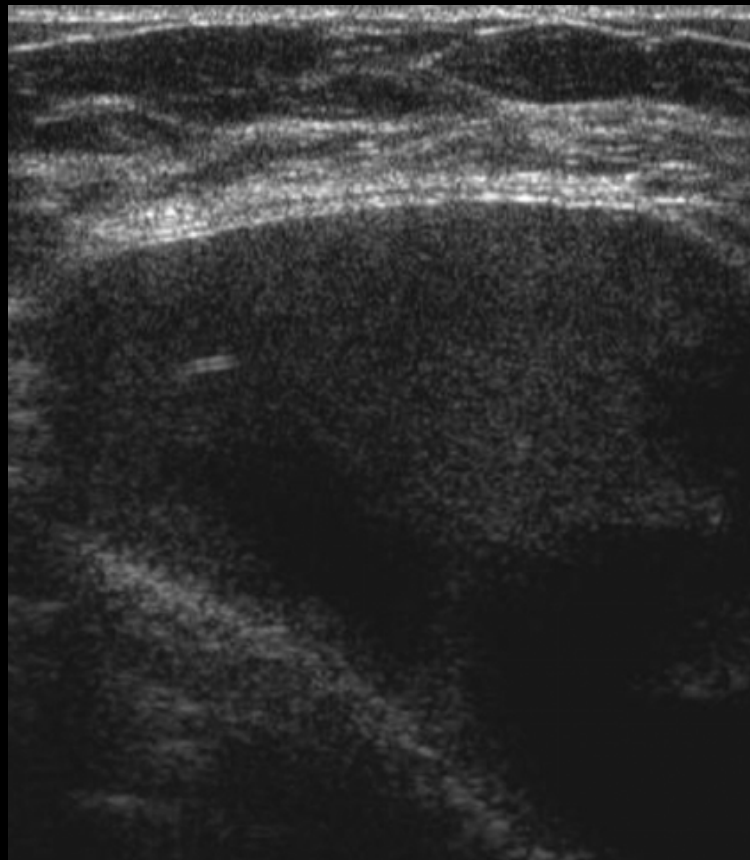
Implant Integrity - Ultrasound

- Normal, NO Intracapsular Rupture
 - “Reverberation Artifact”
 - Multiple parallel lines traversing through implant at various levels, from reverberation artifact from anterior wall, **USE HARMONICS to reduce artifact**



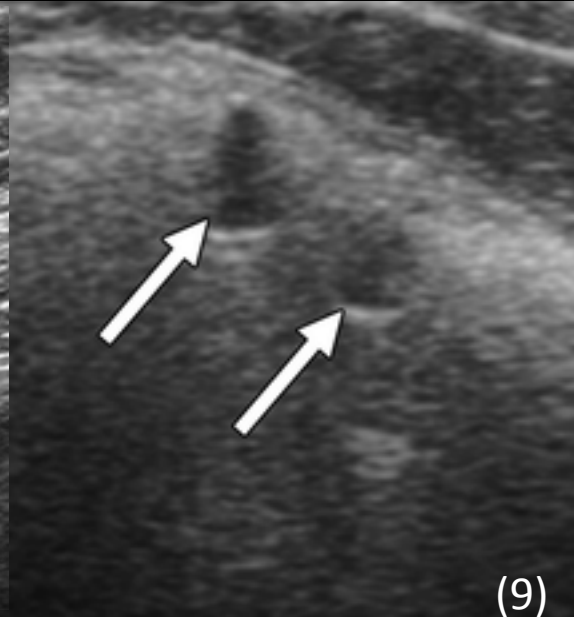
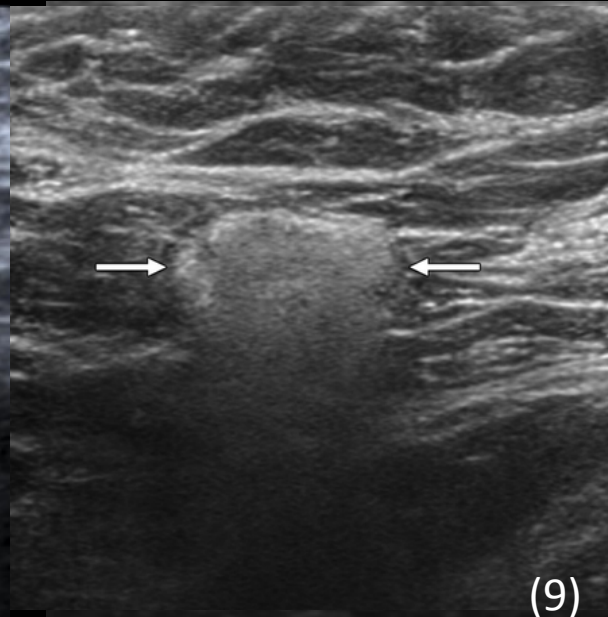
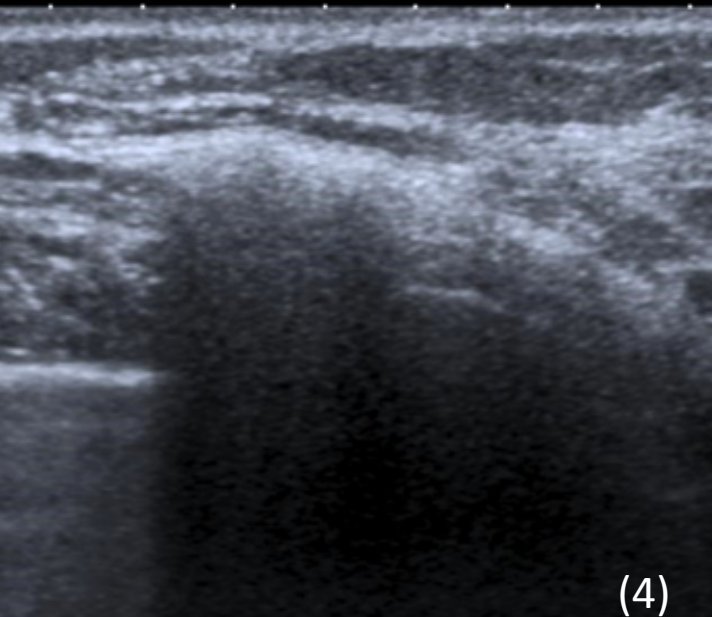
Silicone Implant Rupture - Ultrasound

- Suspicious Sign of **Intracapsular Rupture**
 - “Low level internal echoes” within implant



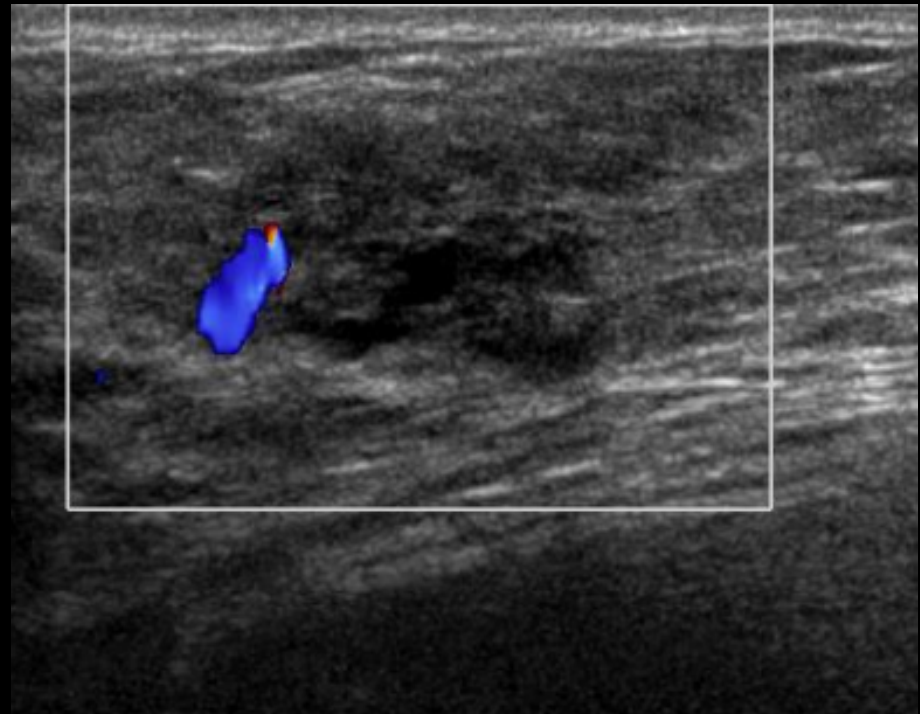
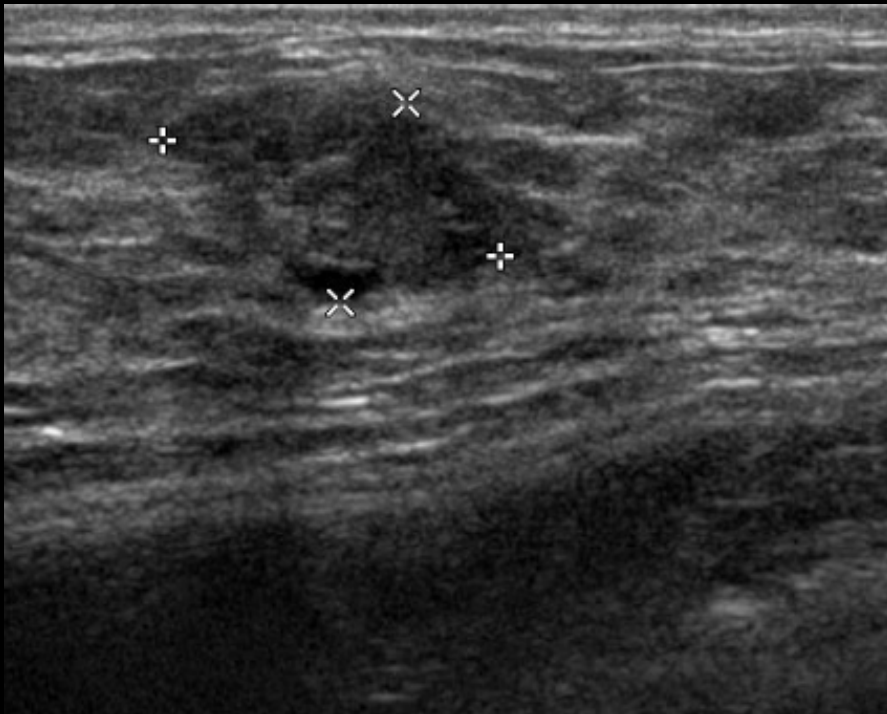
Silicone Implant Rupture - Ultrasound

- Definite Sign of Extracapsular Rupture
 - “Snowstorm Sign”
 - Echogenic, hypoechoic, or anechoic nodules with posterior inhomogeneity/loss of interfaces due to silicone attenuating US beam



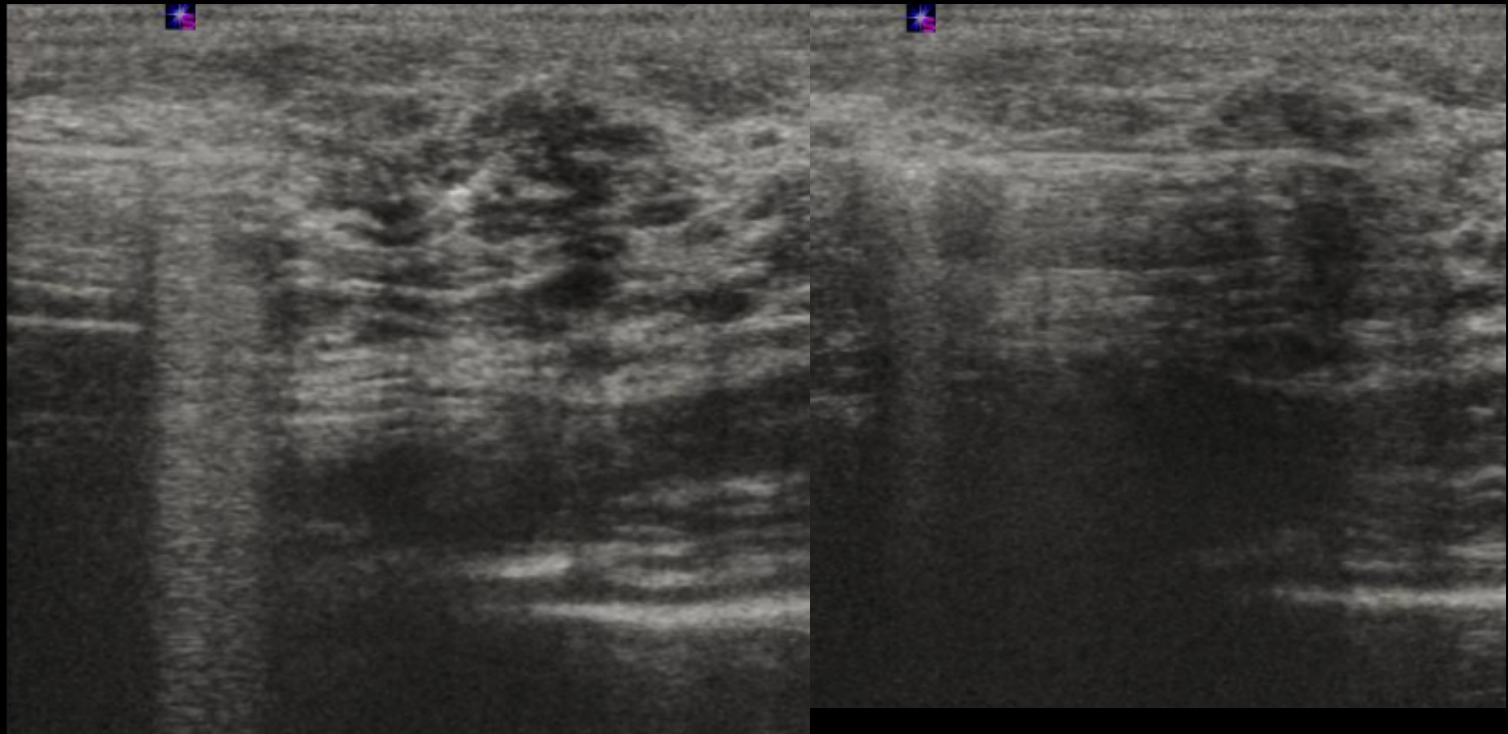
Screening for Breast Cancer with Breast Implants

- Eg . 53 yo F with implants, new R palpable lump, on US was a focal irregular hypoechoic mass with echogenic halo



Screening for Breast Cancer with Breast Implants

- Eg . 53 yo F with implants, new R palpable lump, US-guided core biopsy performed, ensuring trajectory parallel to implant → **DCIS**



Screening for Breast Cancer with Breast Implants

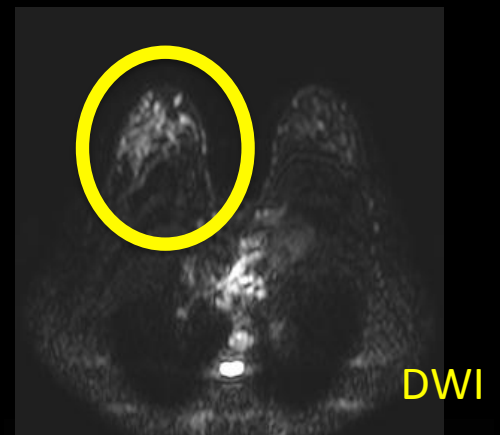
- Eg. same case of DCIS on MRI → regional asymmetric non-mass-like enhancement of the entire R upper breast



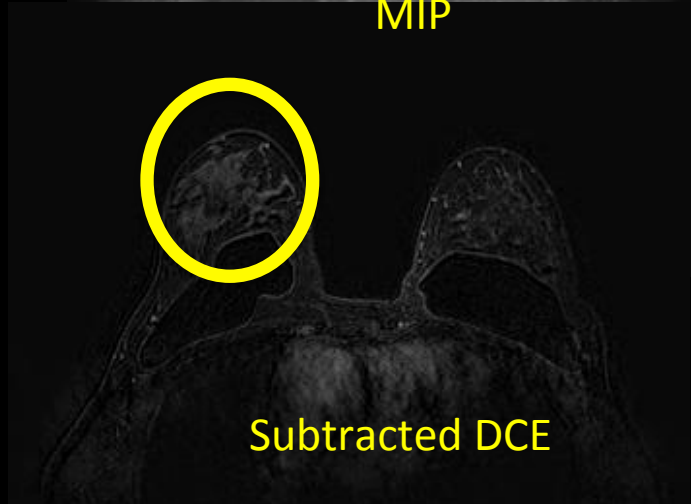
MIP



T2-Fat suppressed



DWI



Subtracted DCE



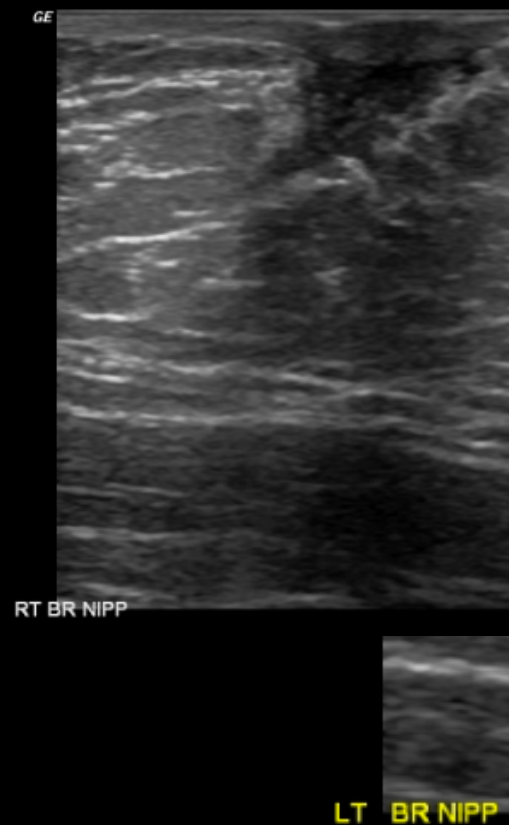
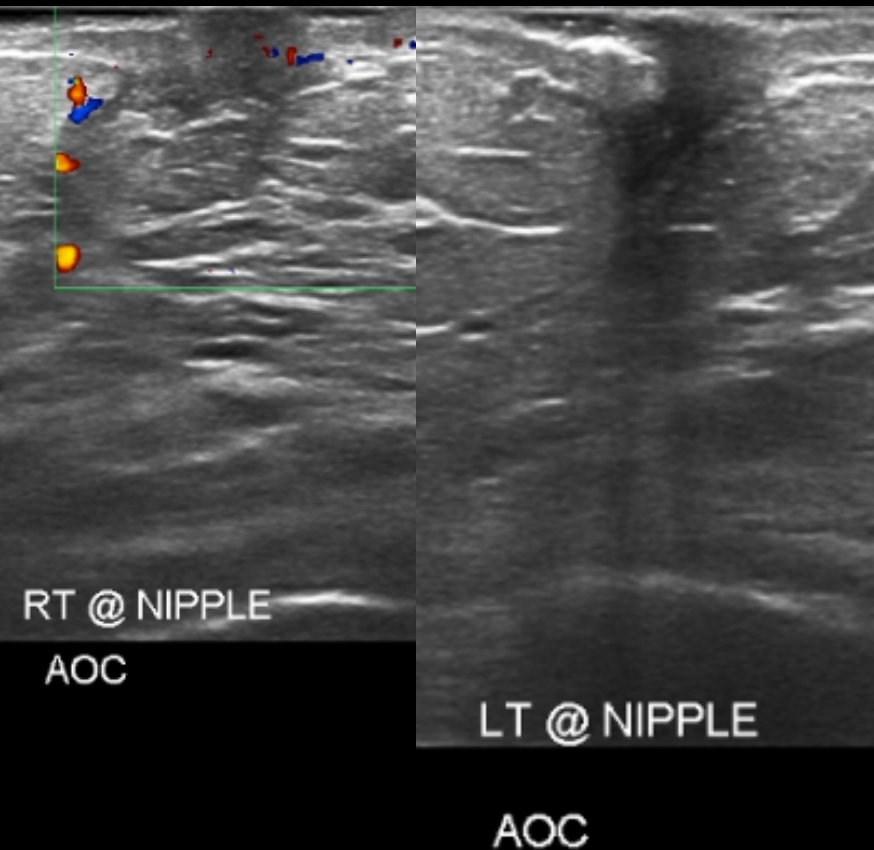
T2-Non-Fat suppressed



ADC

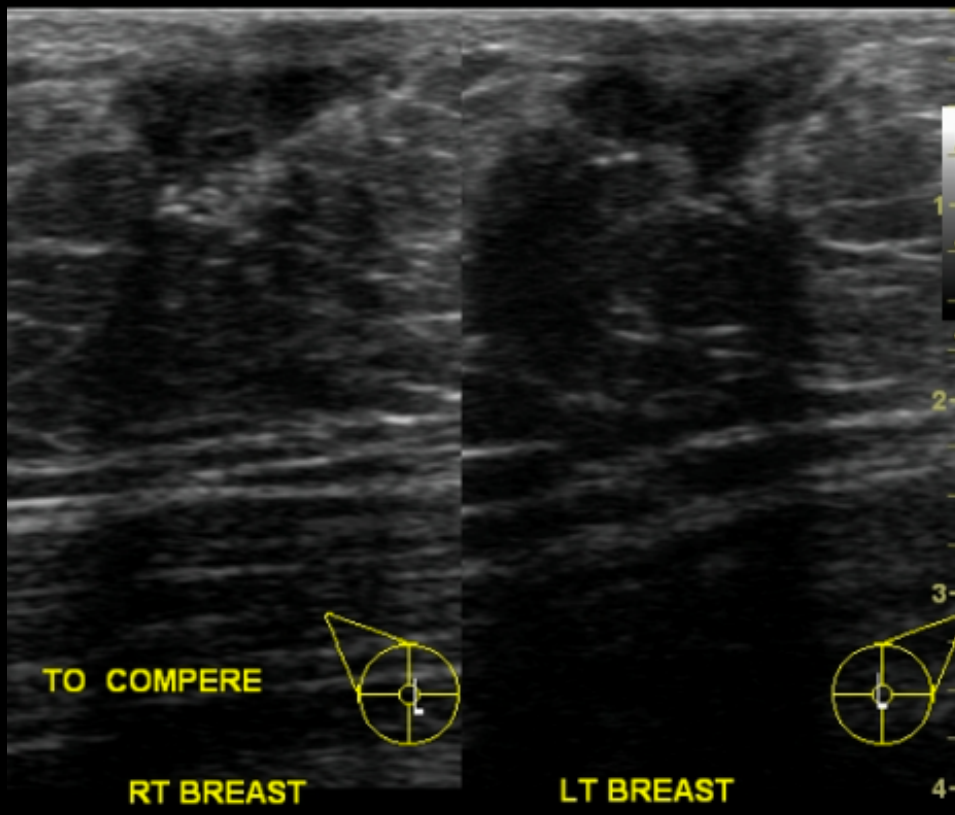
(Male) Gynecomastia

- Typical clinical history:
 - “Tender periareolar lump”



(Male) Gynecomastia

- Typical clinical history:
 - “Tender periareolar lump”



Back to the ...Overview

3 things to ask yourself for every breast US that you do:

1. “Why is this patient here?”

Have we answered the question? (even if the lump correlates with just a dense band of fibroglandular tissue)

1. “Could this be cancer?”

Go with the single most suspicious finding

2. “Have I shown the finding well enough?”

to avoid calling a cancer a “fibroadenoma”

to avoid following or biopsying

simple or only minimally complicated cysts

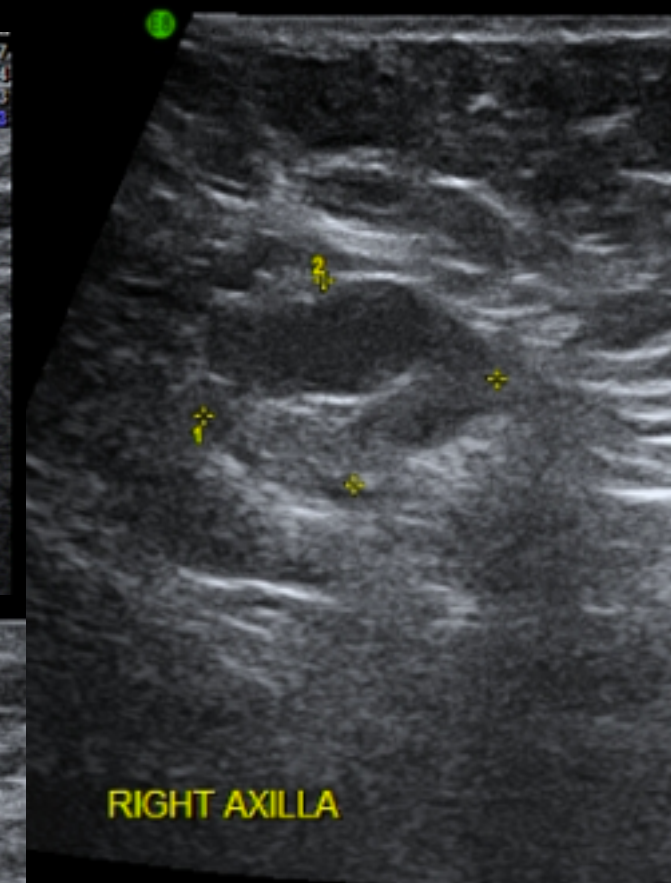
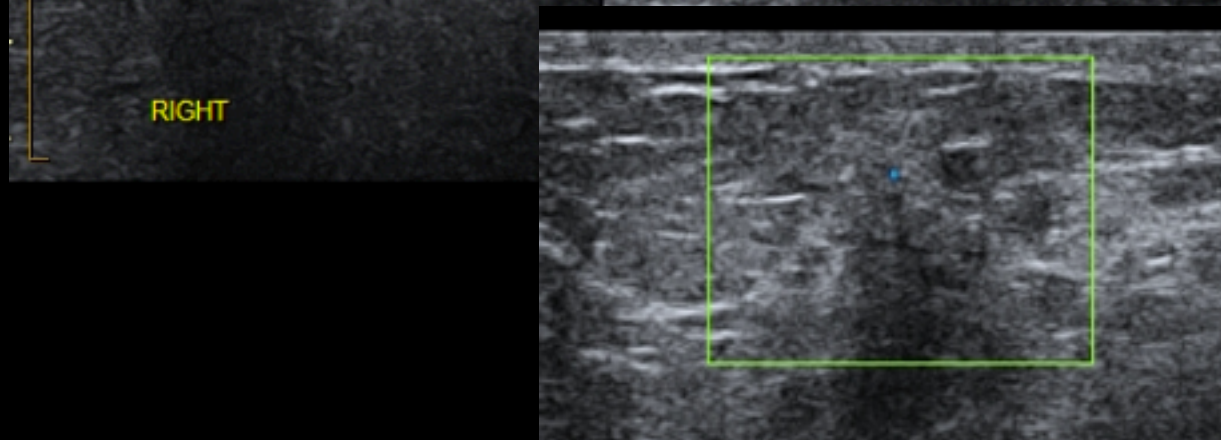
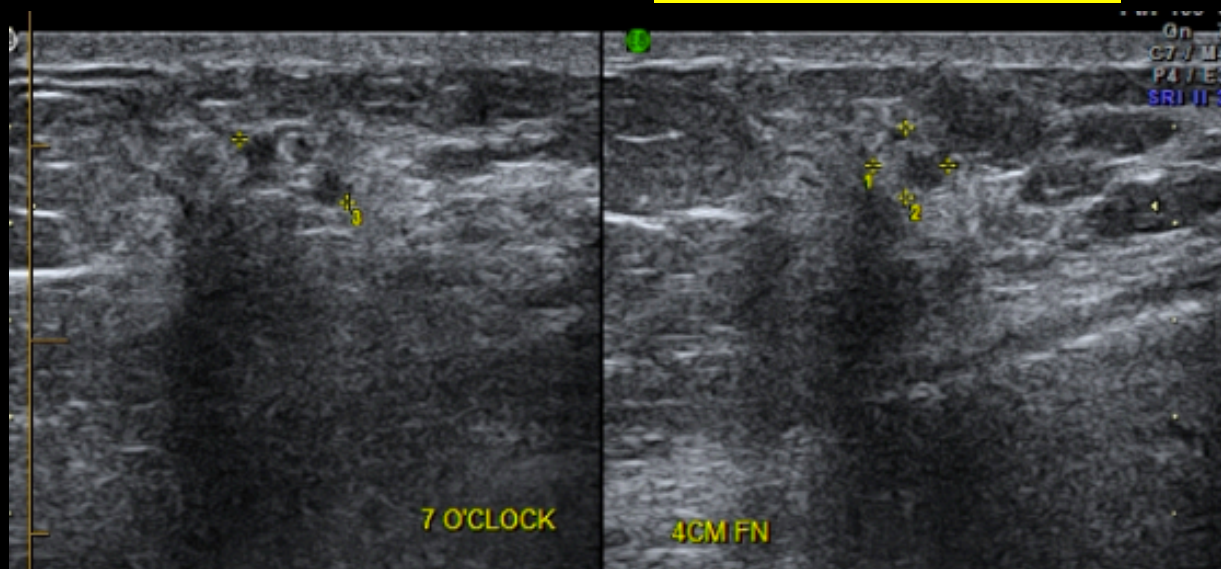
Summary

- Screening vs. Diagnostic Ultrasound
- Basic Breast Ultrasound Protocol & Positioning
- Background Breast Parenchyma - a limitation?
- **Breast Cancer features on US**
- Cysts
- Dilated Ducts
- Breast Implants
- Gynecomastia
- (Real-life) Cases

Cases

1. “tiny cysts”?? No! Necrosis associated with breast cancer, w/ Axillary LN with cortical thickening

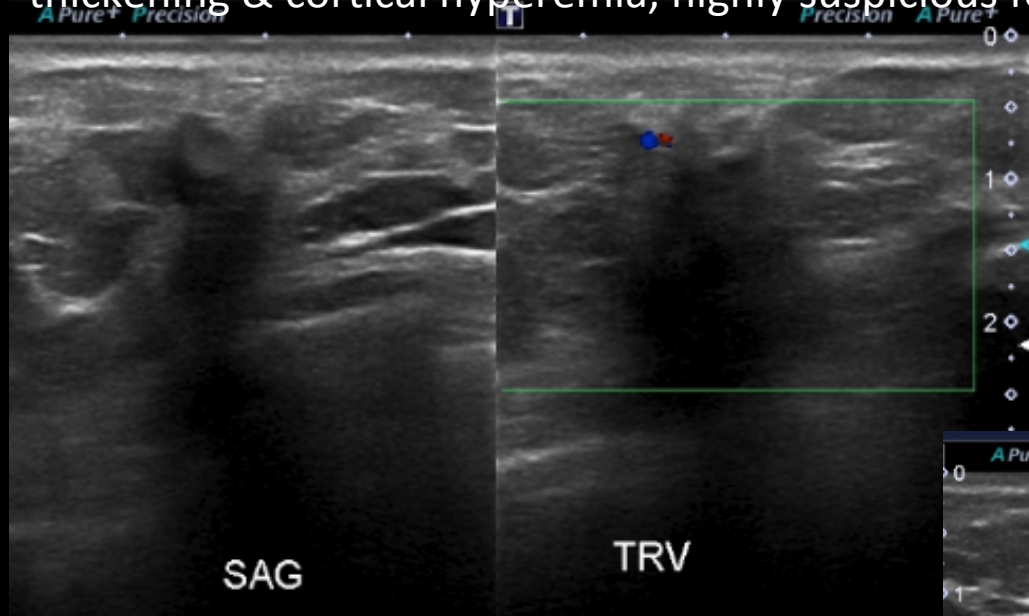
Note the **ABNORMAL** shadowing



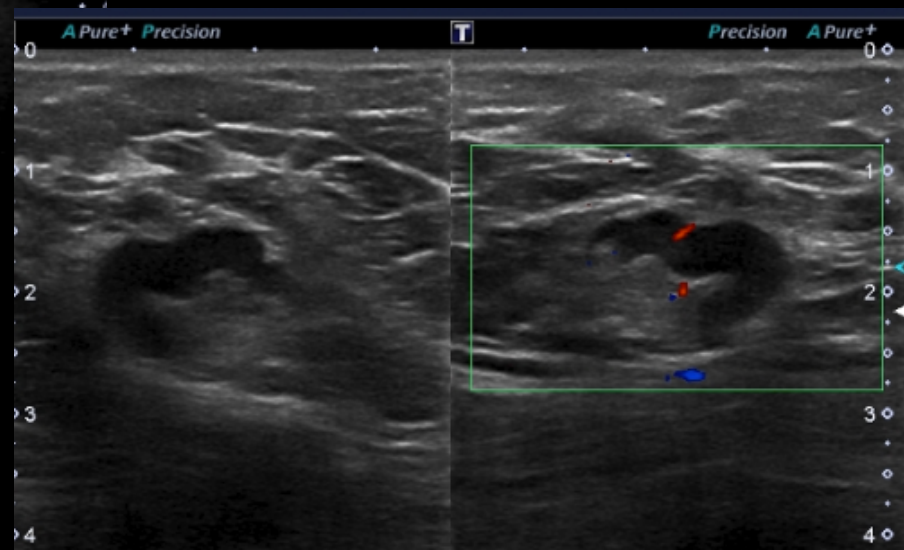
Cases

1. This is the same lesion, with harmonics:

Markedly Shadowing, hypoechoic Area/Mass with an Axillary LN with mild cortical thickening & cortical hyperemia, highly suspicious for breast cancer



*IDC NOS with metastatic axillary LN
(i.e. Locally-Advanced Breast
Cancer)*



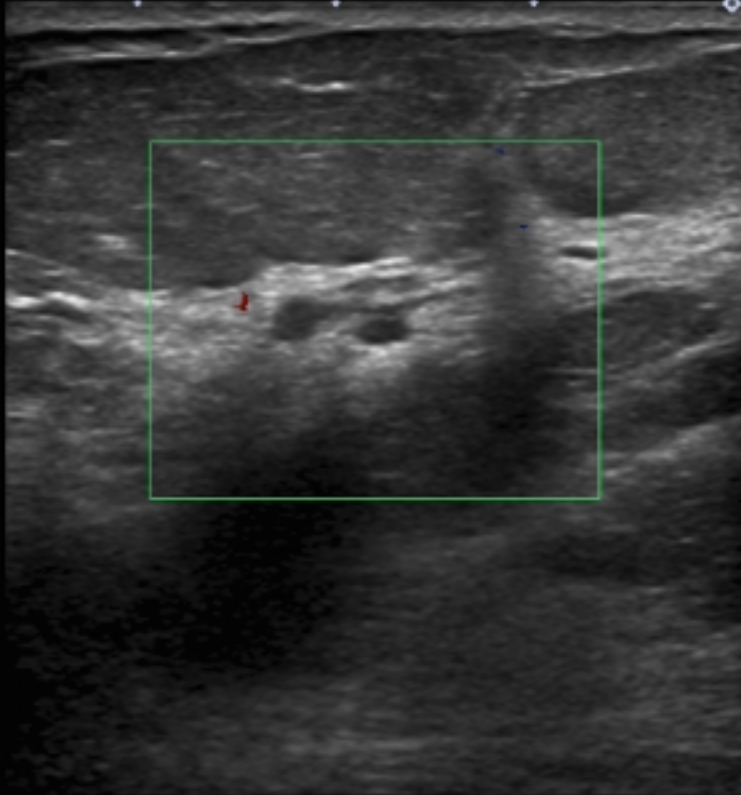
Cases

2. 67 yoF, “new R breast lump/thickening with partial nipple inversion”

→ Abnormal mammogram (marked architectural distortion)

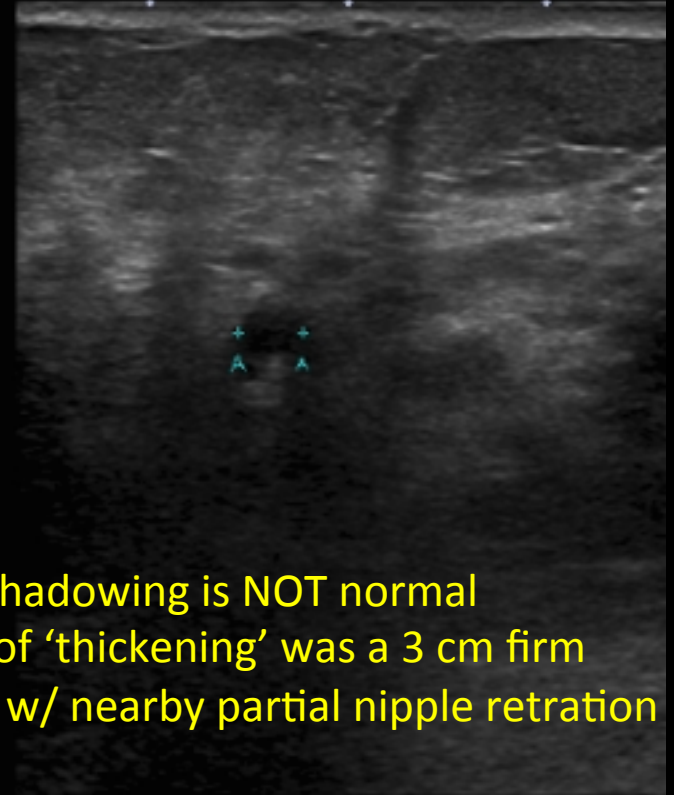
→ More tiny cysts? No! Again, note the prominent shadowing.

T



RT 10 OCL 2 OCL

T

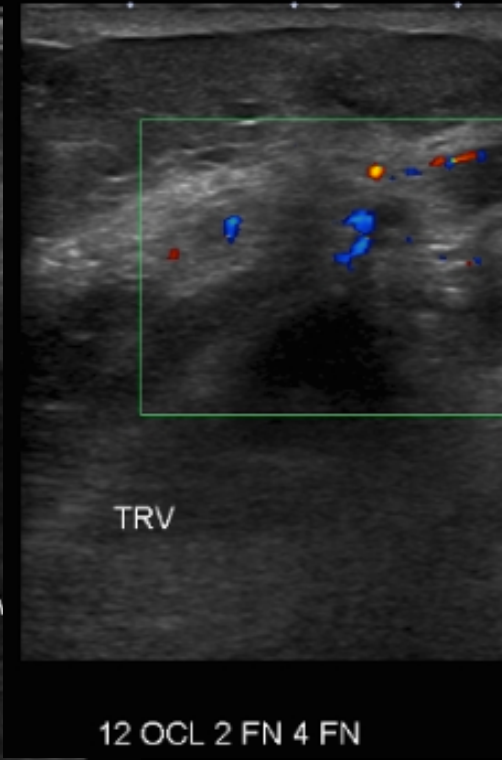
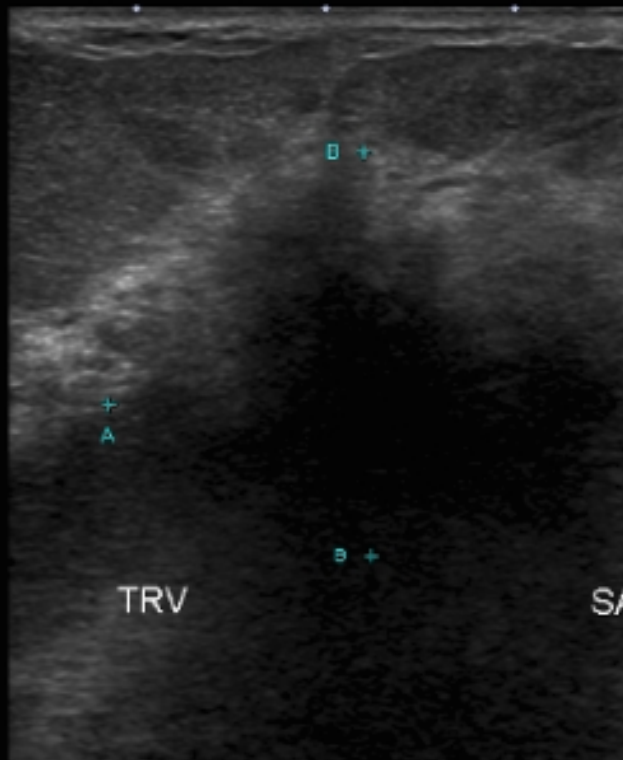
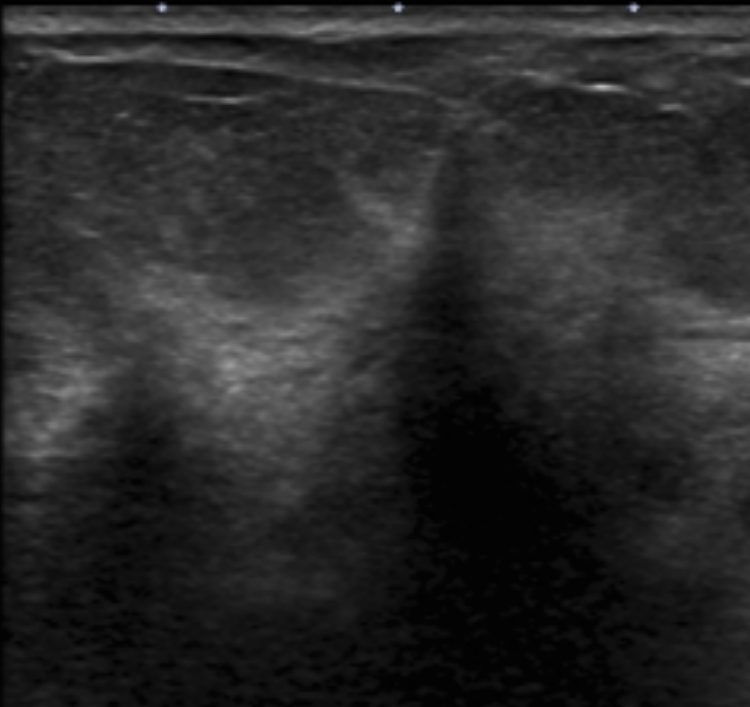


1. This shadowing is NOT normal
2. Area of 'thickening' was a 3 cm firm lump, w/ nearby partial nipple retraction

RT 12 OCL 2 FN

Cases

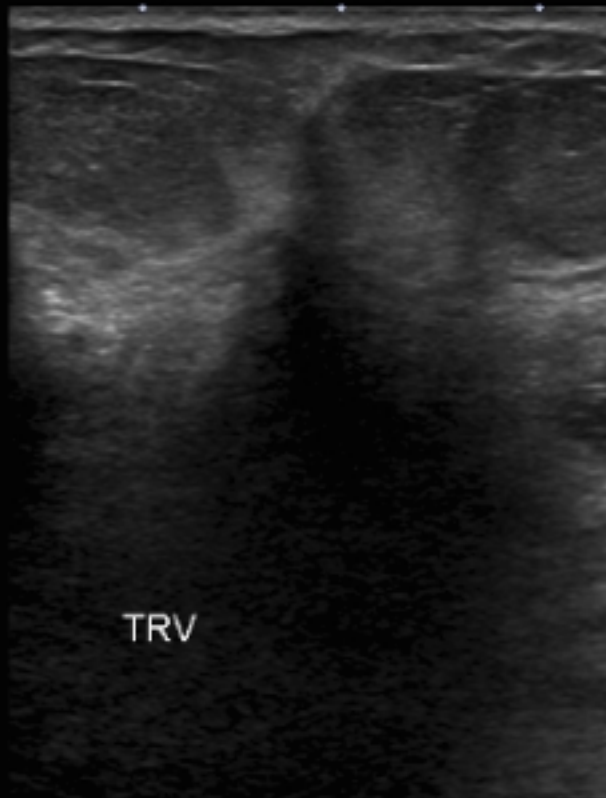
2. On physician-supervised US, a 3 cm markedly hypoechoic area with peripheral hypervascularity, highly suspicious for invasive breast cancer (pathology pending)



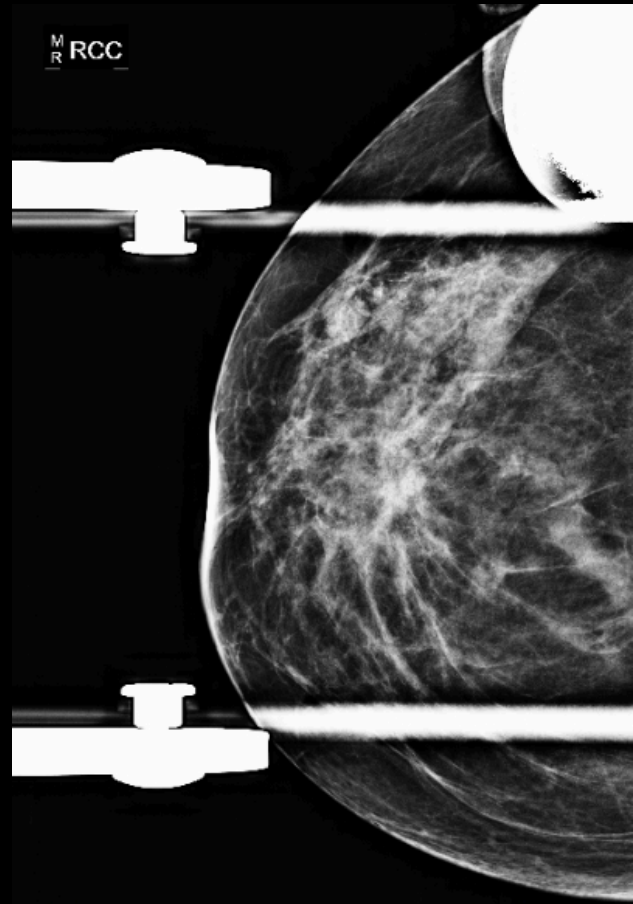
12 OCL 2 FN 4 FN

Cases

2. Ultrasound – Mammographic correlation

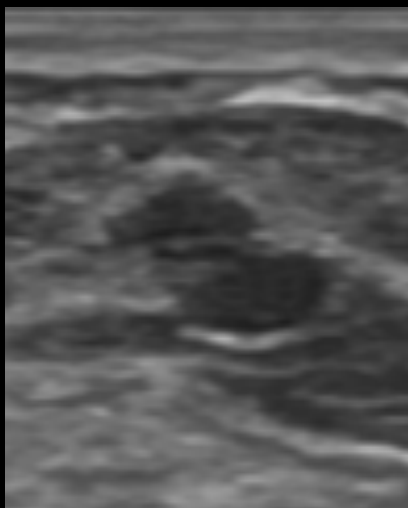
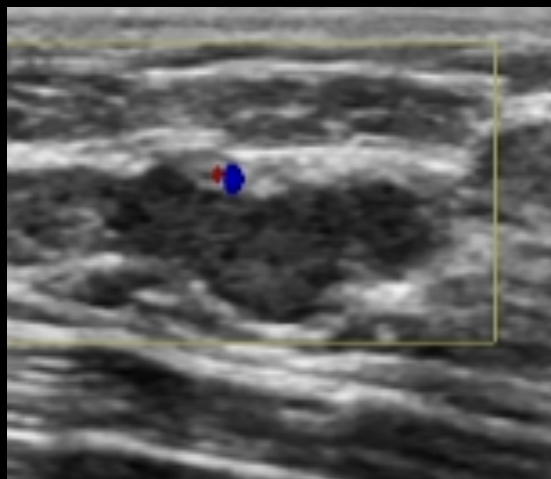
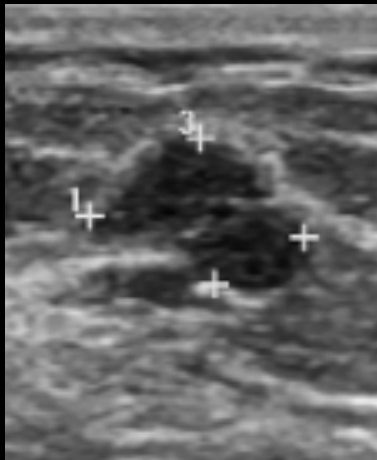


12 OCL 2 FN 4 FN

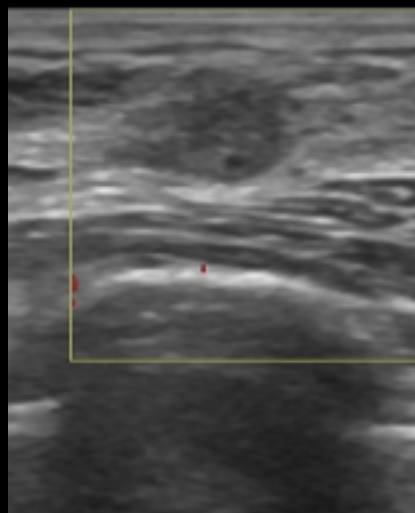


Cases

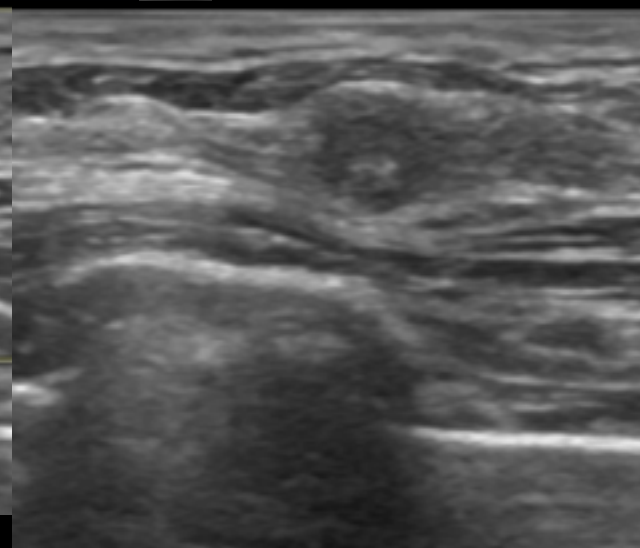
3. 40 yoF, Fibroadenoma? No. Notice the indeterminate US features (angular margins, microlobulated, enveloping fat)



Papilloma w/ DCIS



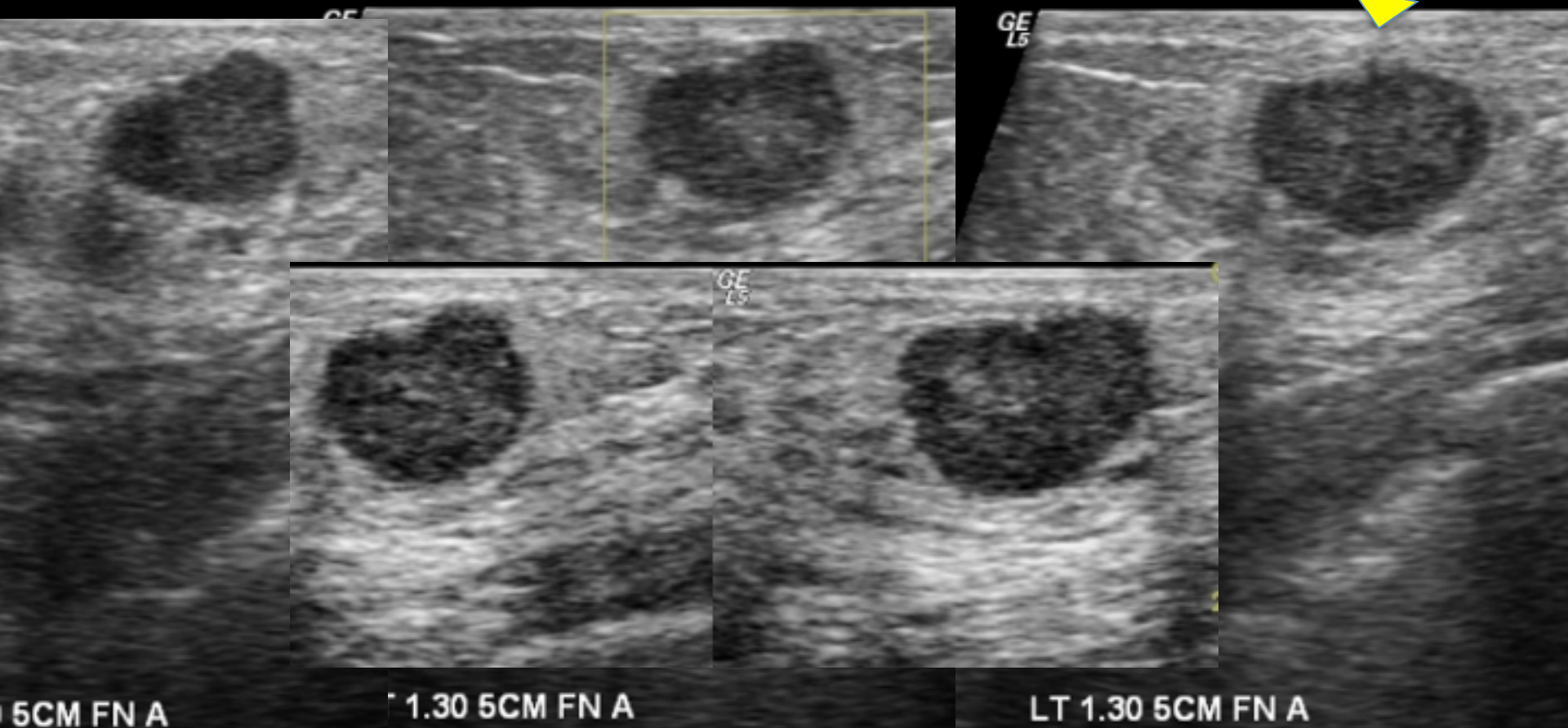
IDC NOS



Cases

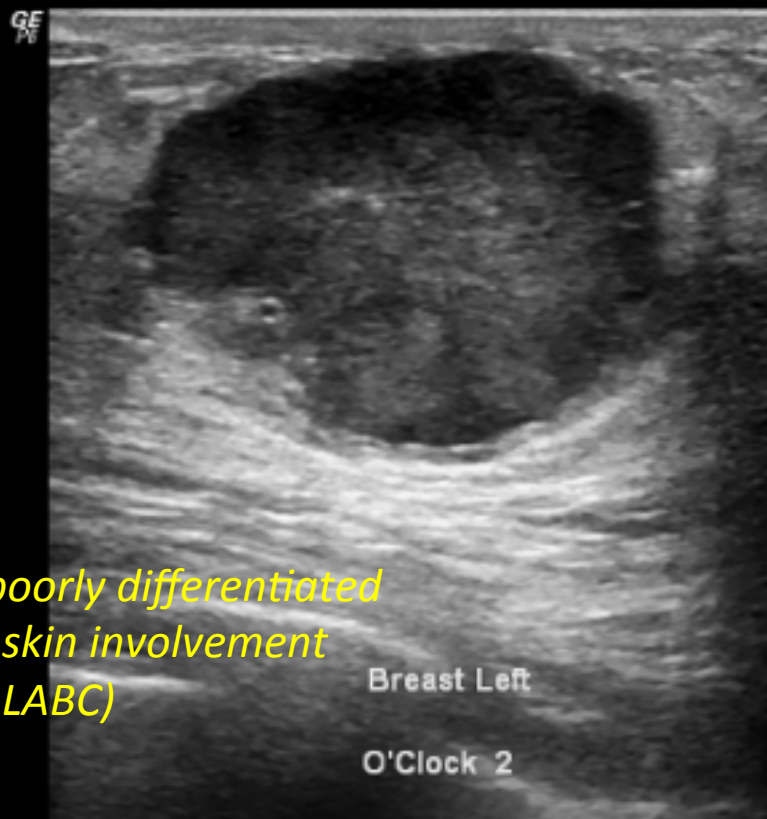
4. 50 yoF, "1 x 1 cm palpable firm mass"

→ fibroadenoma? No! Notice the microlobulated margins, almost round shape, and at least 1 spicule extending anteriorly towards skin

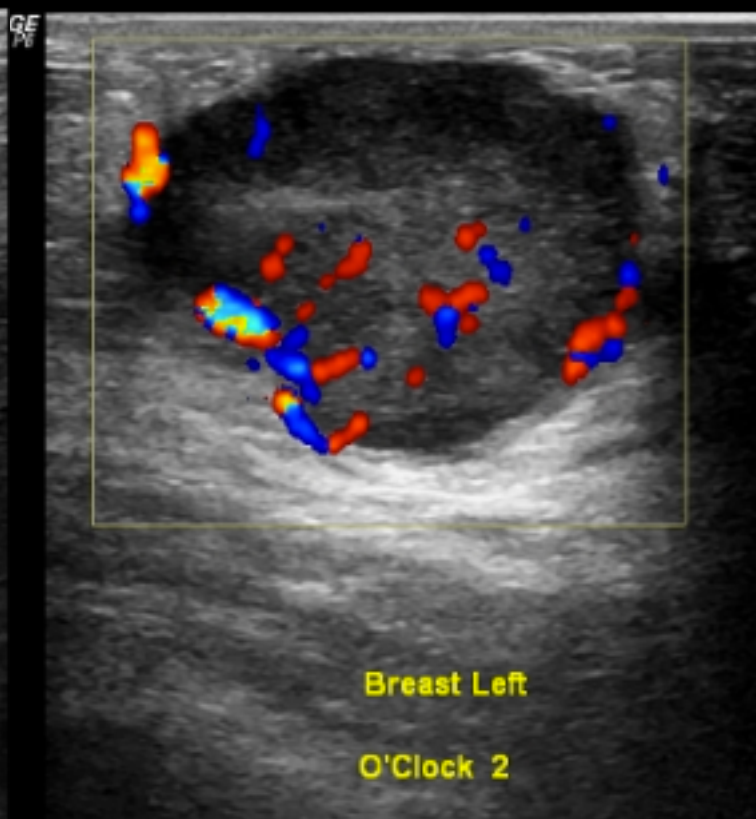


Cases

4. Hypervascular, microlobulated, heterogeneous, suspicious for breast cancer



*IDC poorly differentiated
with skin involvement
(aka LABC)*



Cases

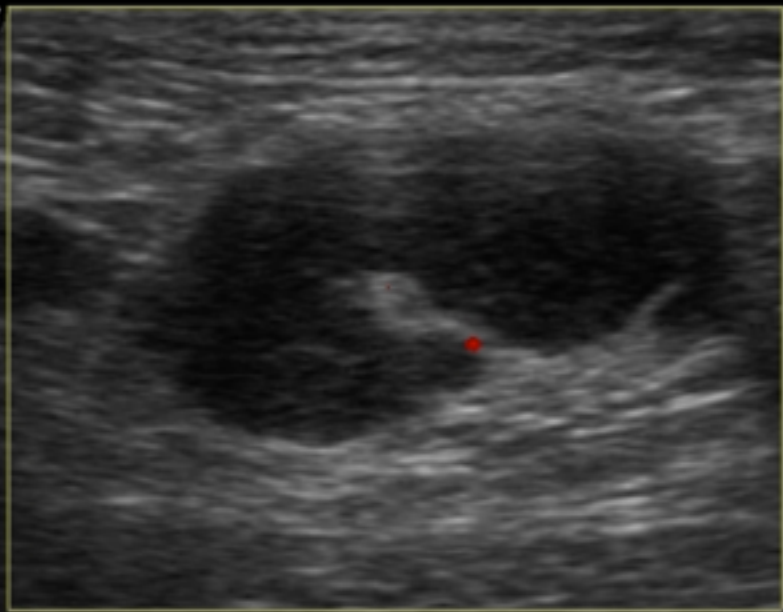
5. 50 yo, “axillary lump NYD”

→ Large R axillary LN with marked cortical thickening & flattened/deformed fatty hilum

→ Indistinct, microlobulated, round, heterogeneous hypoechoic mass in the breast

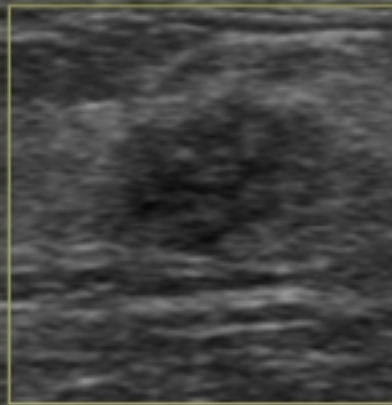
→ primary breast cancer with axillary metastases

GE
LS



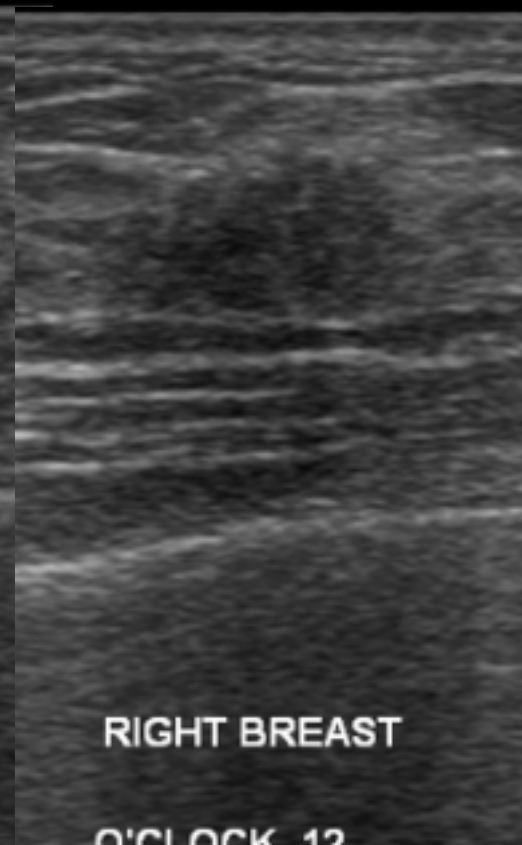
RIGHT AXILLA LUMP

IDC NOS w/ metastatic axillary lymphadenopathy (aka LABC)



RIGHT BREAST

O'CLOCK 12

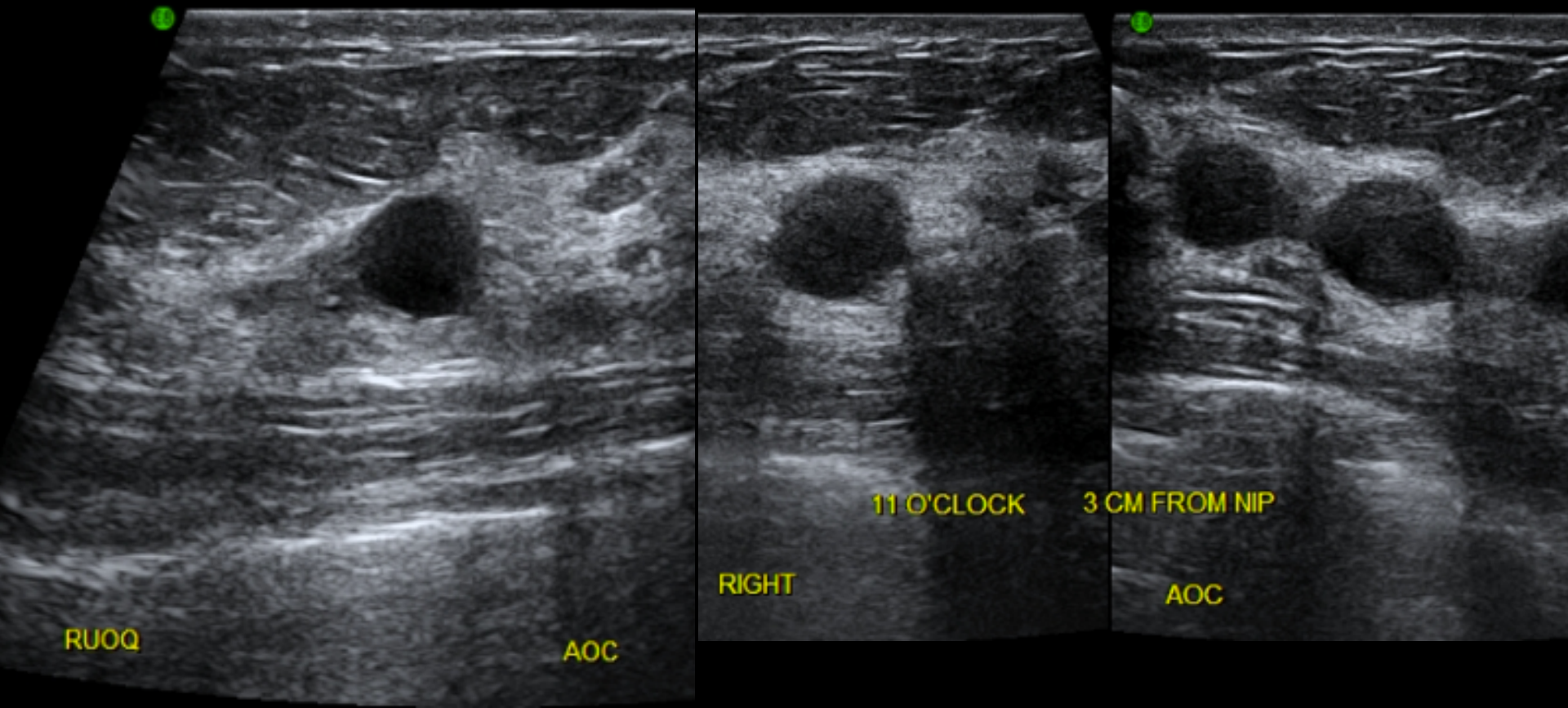


RIGHT BREAST

O'CLOCK 12

Cases

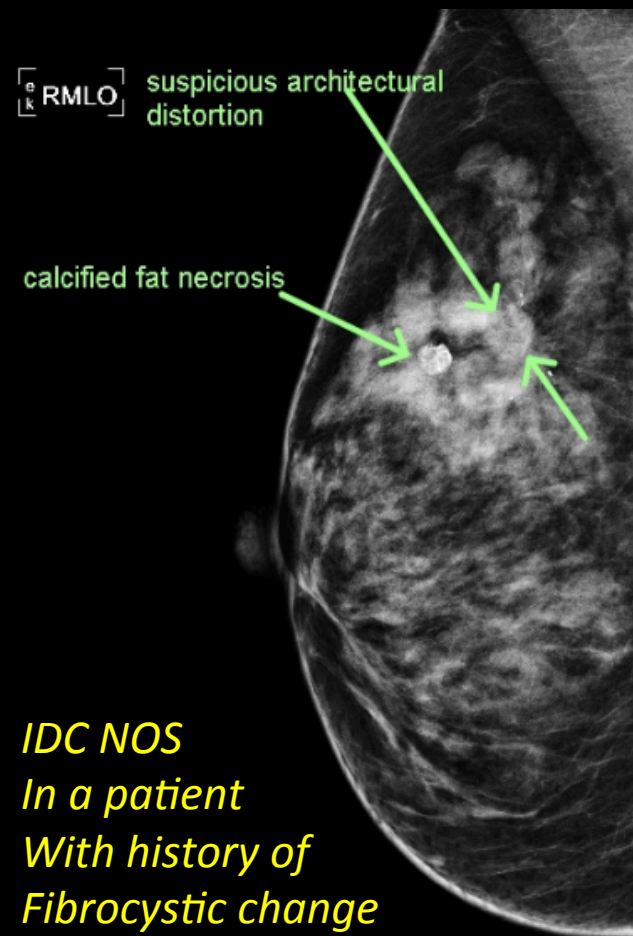
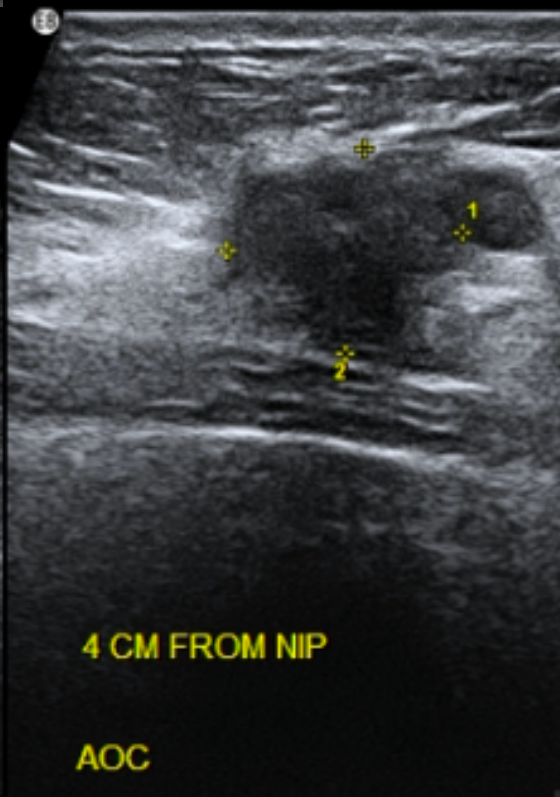
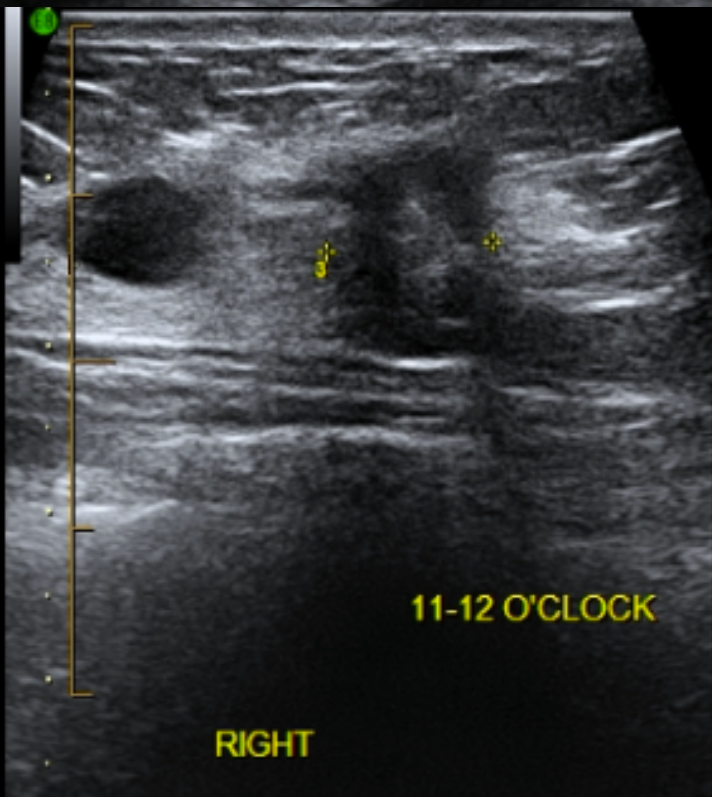
6. 47yoF, “known fibrocystic breasts, now new RUOQ lump”



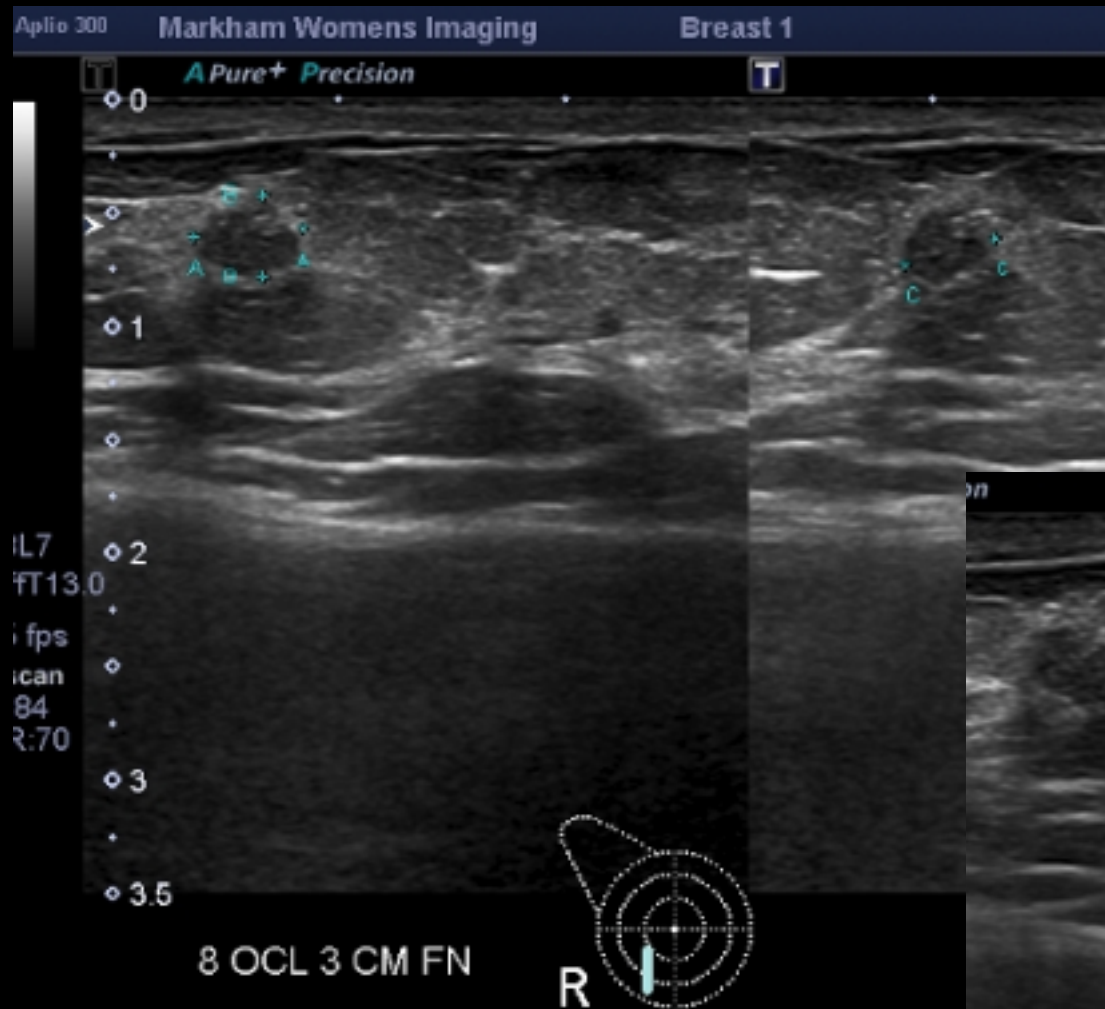
Cases

6.

47yoF, "known fibrocystic breasts, now new RUOQ lump"

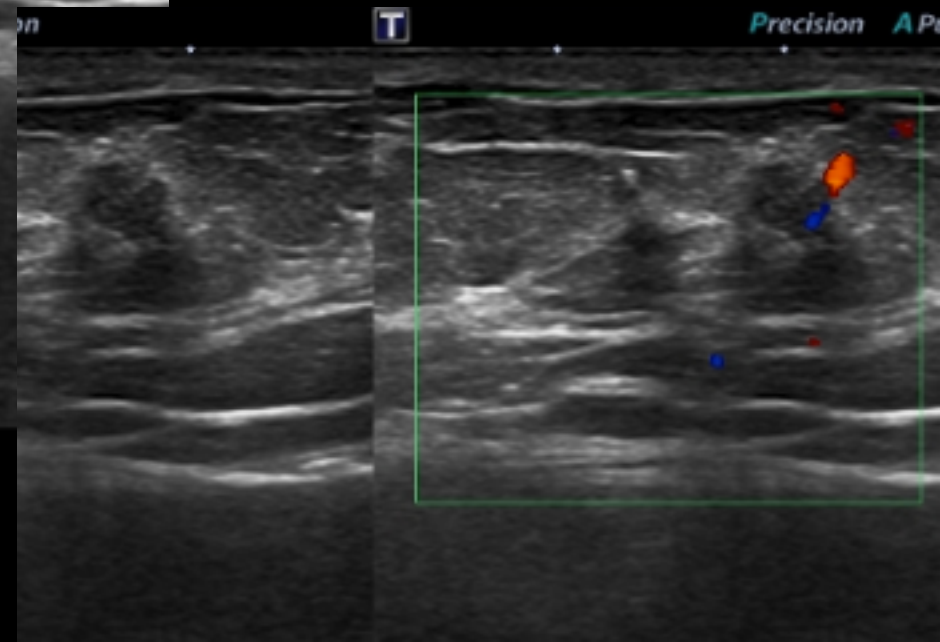


Cases



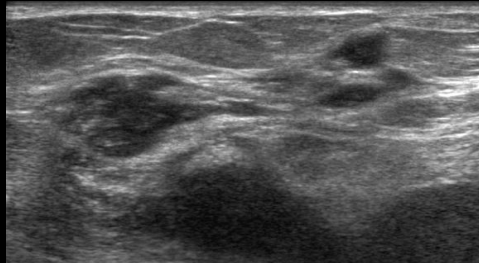
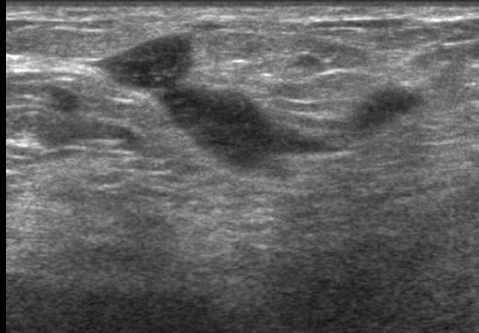
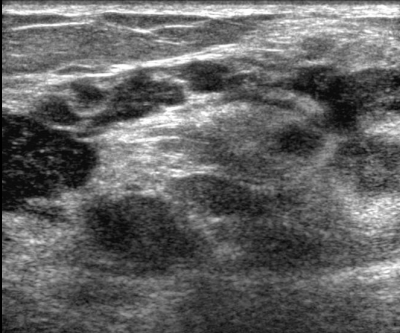
7.
48yoF, "routine screening,
Implants"

*IDC NOS in a pt
with breast implants*



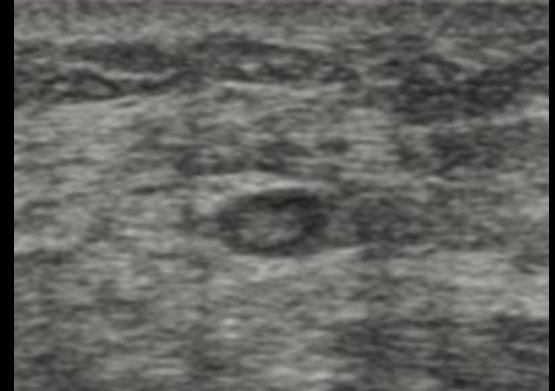
Cases - Benign Disease

8.



*Granulomatous mastitis in a
Diabetic patient*

9.



Benign Intramammary LN

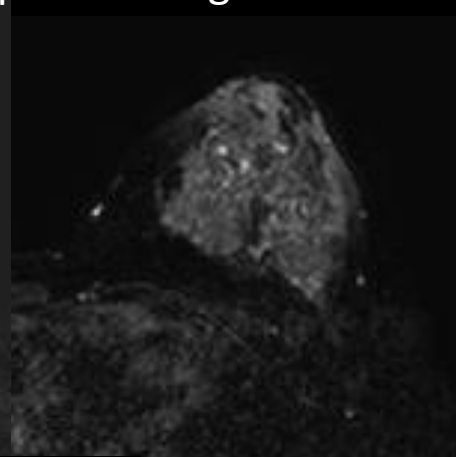
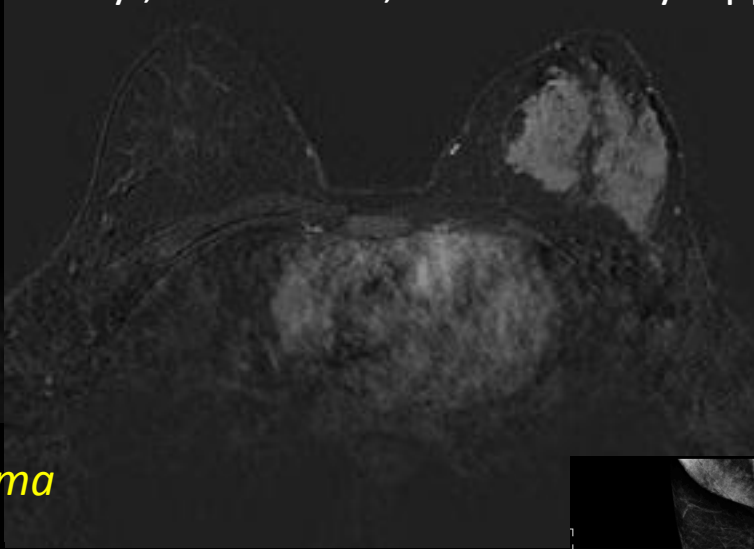
10.



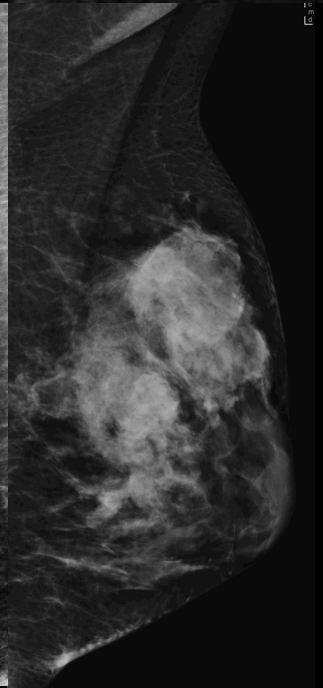
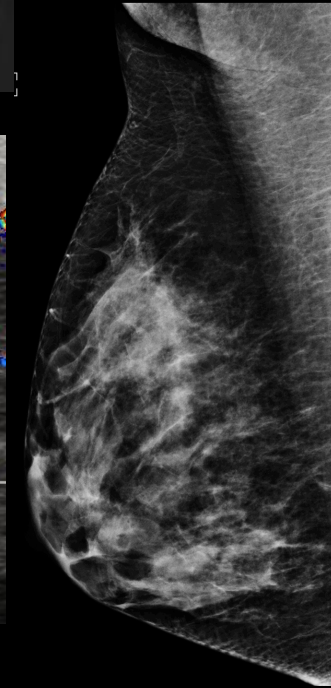
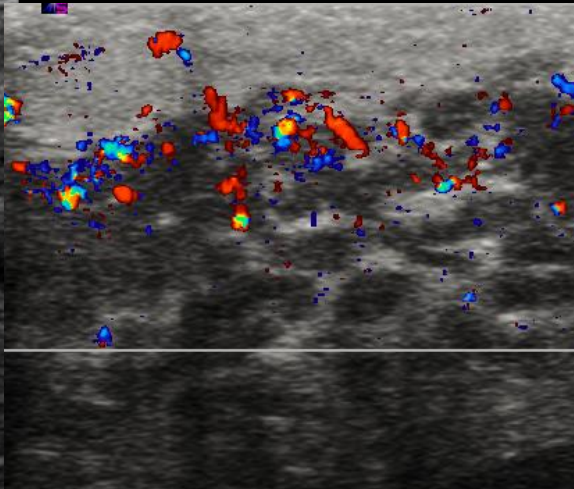
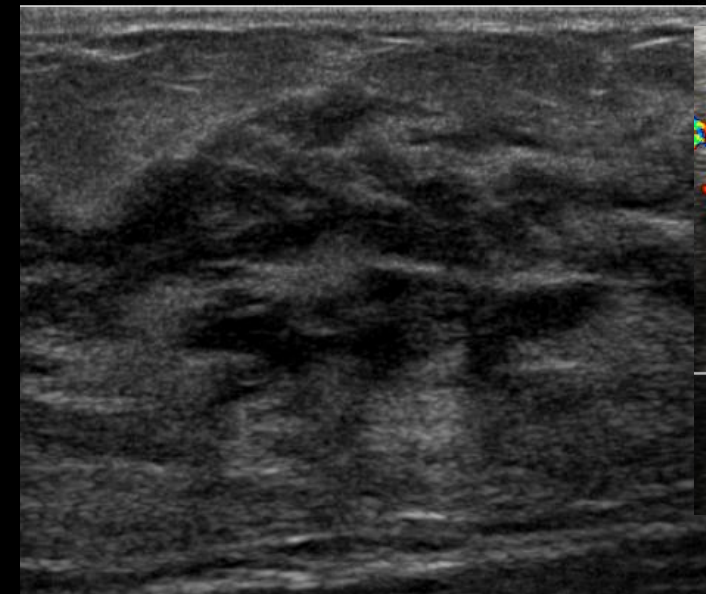
Sclerosing adenosis of FCC

Cases - Cancer

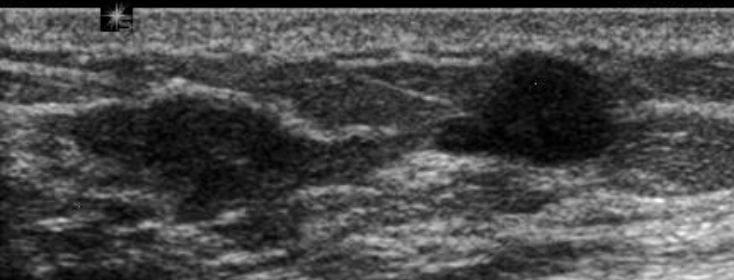
11. 16yo, Palpable 'Left upper nodularity', tenderness, recent bloody nipple discharge



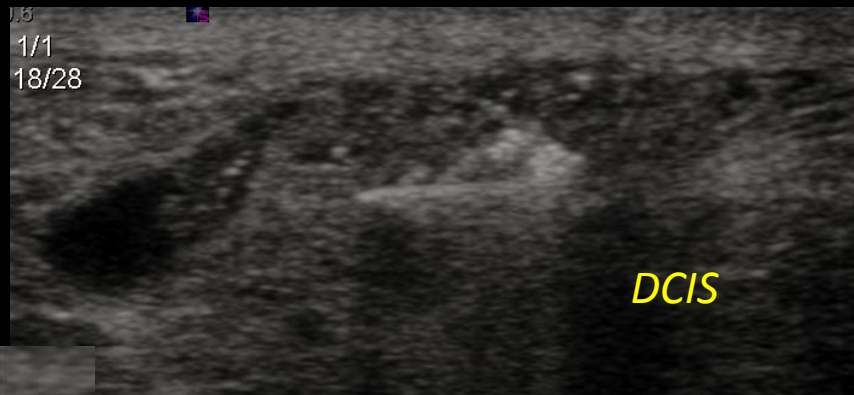
DCIS with invasive tubular carcinoma



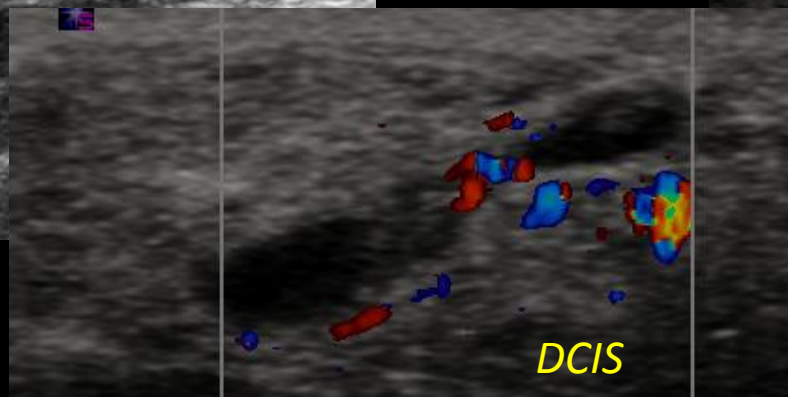
Cases - Cancer



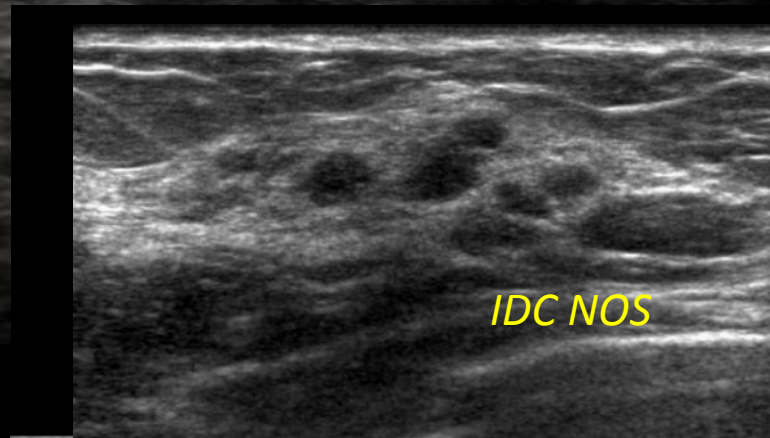
DCIS



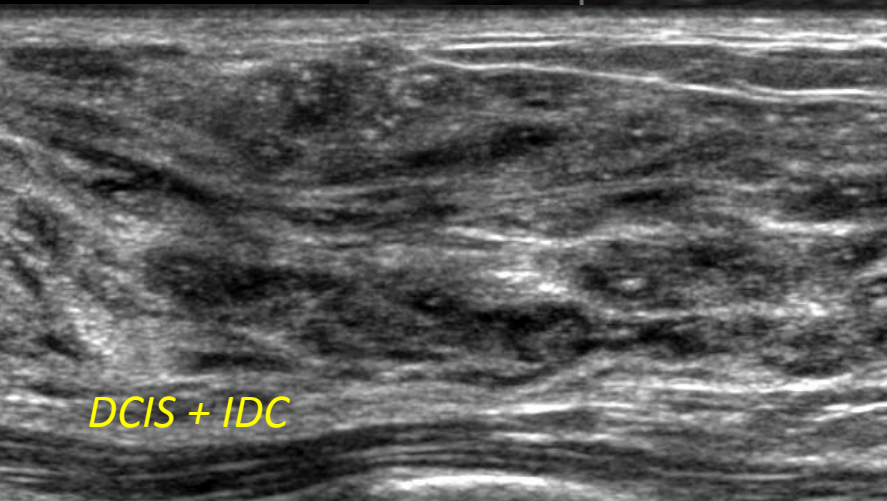
DCIS



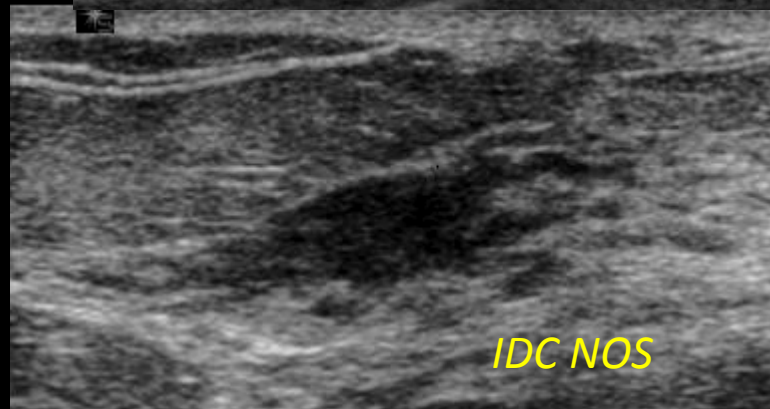
DCIS



IDC NOS



DCIS + IDC

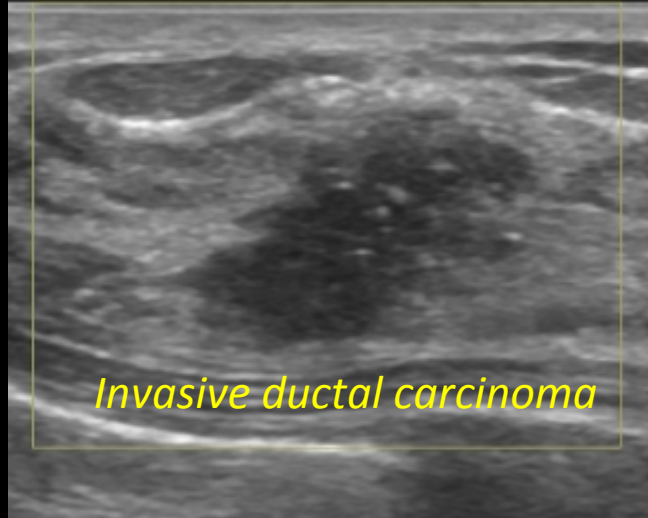


IDC NOS

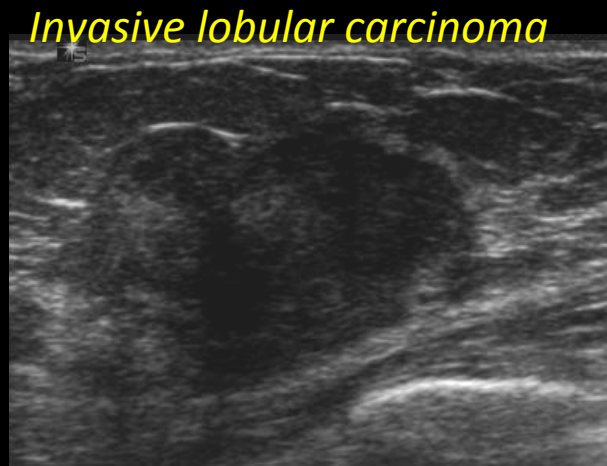
Cases - Cancer



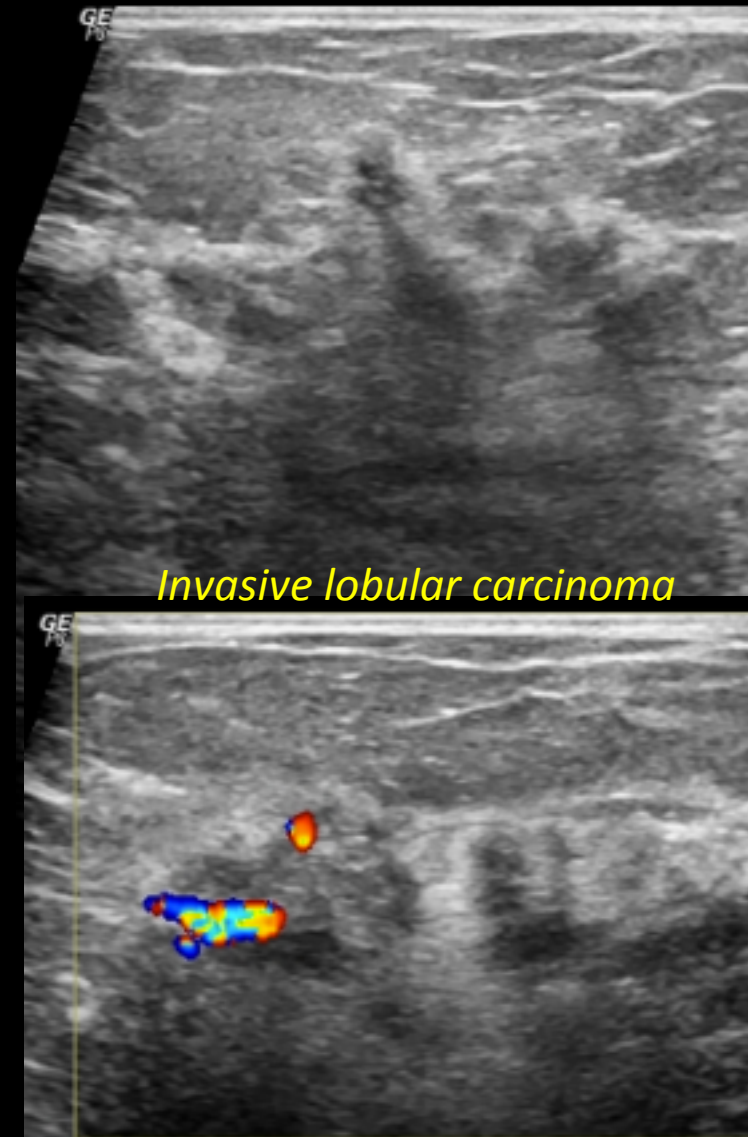
Inflammatory ca



Invasive ductal carcinoma



Invasive lobular carcinoma



Invasive lobular carcinoma

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