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*Feature Analysis:
 BI-RADS for Ultrasound*

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Disclosures

- Delphinus—Clinical Advisory Committee
- Seno Medical—Medical Advisory Board
- Siemens Ultrasound—Research support, consulting, and speaker


Objectives

- Use feature categories and descriptors to recognize patterns
- Apply *combined* features: the big three for benign assessment—**shape, margin, orientation**
- Accurate interpretation depends on image quality: US aesthetics
- Recognize US tissue composition for multimodality correlation
- Explain *architectural distortion* and other “non-mass findings” in US (in 5th ed. Associated Features)—
- Apply feature analysis to help stratify category 4 to ↑specificity
- Explore applications of focused HH US to whole breast HH and augmented US (AUS)


BI-RADS® 5TH EDITION
Breast Imaging—Reporting and Data System

Practice management system's important components:

- 1) lexicon of feature categories and descriptors
- 2) recommended reporting structure including
 - ✓ final assessment categories
 - ✓ management recommendations
- 3) a framework for data collection and auditing
- 4) multimodality consistency across mammography, US, MRI



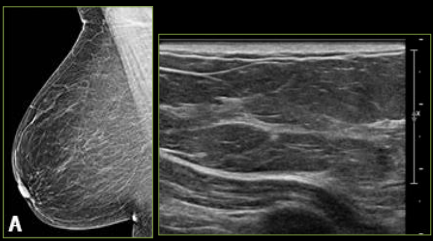
Bernside, E et al. ACR BI-RADS® Experience: Learning From History. J Am Coll Radiol 2009;6:832-868.

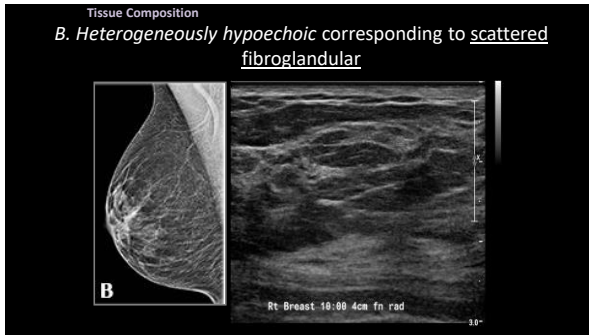


BI-RADS® 5TH EDITION

- Anatomy & Physiology including physiologic changes; male breast
- Image Quality
- Tissue Composition
- Feature Analysis: the Lexicon
 - Masses
 - Calcifications
 - Associated Features
 - Special Cases—e.g. LN; postsurgical
- Reporting Systems
- Guidance
- Frequently Asked Questions (FAQ's)
- Appendix: Table of US Lexicon Classifications

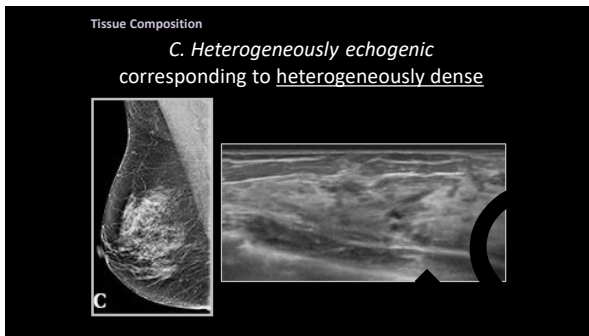
Tissue Composition
A. Homogeneously hypoechoic (Fatty)





US Tissue Composition

- Homogeneous discrete zones of either fat or fibroglandular tissue are good for perceiving and characterizing lesions
- Heterogeneous areas of echogenicity throughout may reduce sensitivity



Indications for Breast US

Diagnostic

- Characterizing masses
- Characterizing masses seen or suspected on mammography or MRI
- Initial imaging technique for young, pregnant, lactating women
- Guiding interventional procedures
- Problems with implants
- Treatment planning for radiation therapy
- Calcifications embedded in dense FG tissue; underlying mass?

Screening and Diagnostic, Whole Breast

- Supplemental dense breast screening (MRI preferred)
- Extent of disease (MRI preferred)
- Follow-up of multiple masses – under consideration especially with AUS
- Correlation with MRI findings

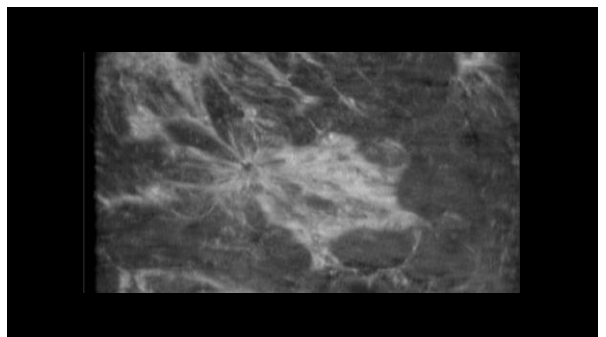
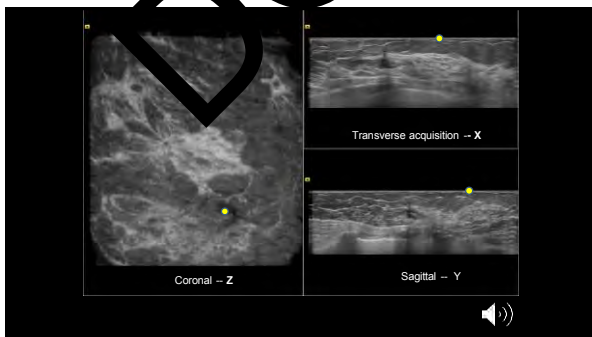
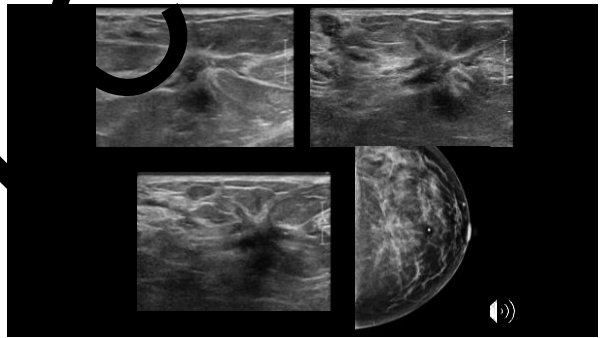
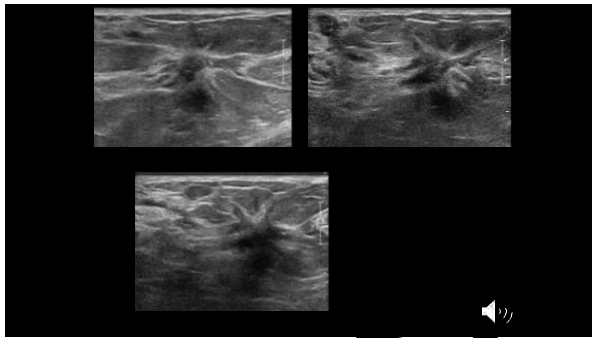
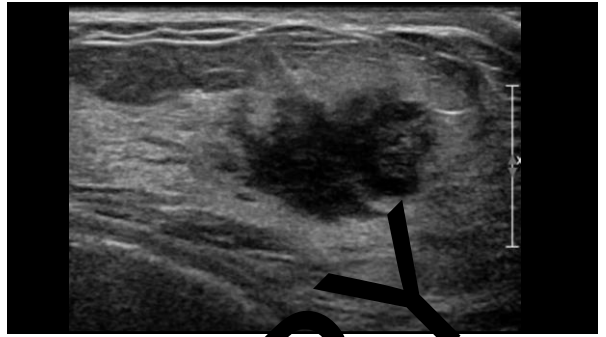
ACR, Practice Parameter for Performance of Breast US, Reston, VA, 2014, 2016
 ACR, Practice Parameter for Whole Breast US for Screening and Extent of Disease, expected publication, 2020

BASIC FINDINGS FOR ASSESSMENT

- Masses:** most important contribution of US; providing specificity to mammo- and some MRI- detected lesions
- Calcifications:** mammo best, but now a separate US lexicon category
- Architectural distortion:** conspicuity on tomo and coronal automated US
 - will look at US manifestations

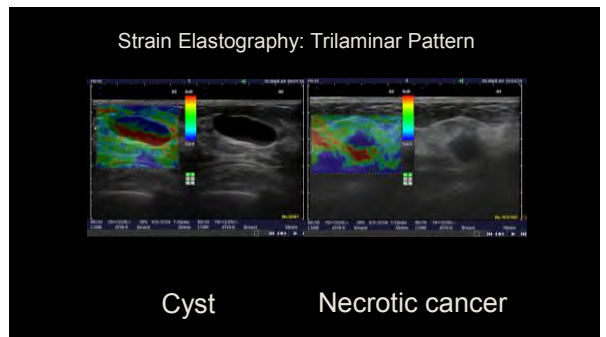
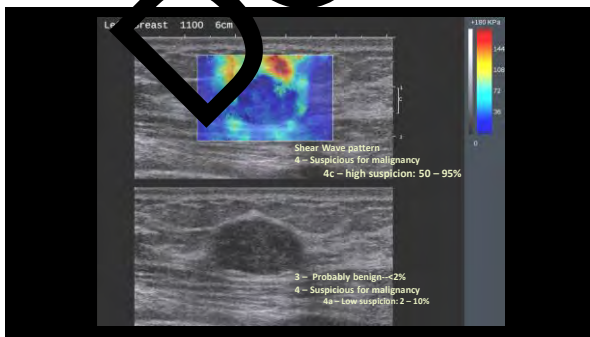
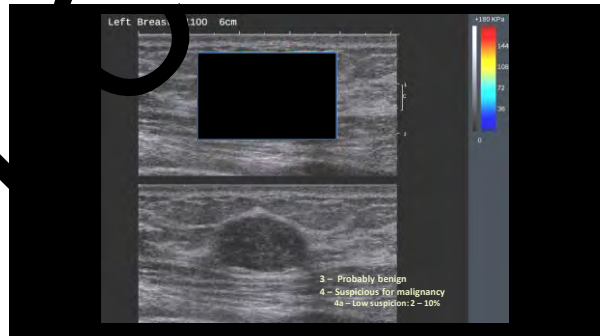
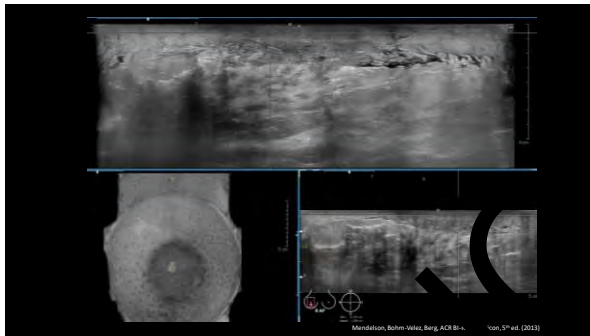
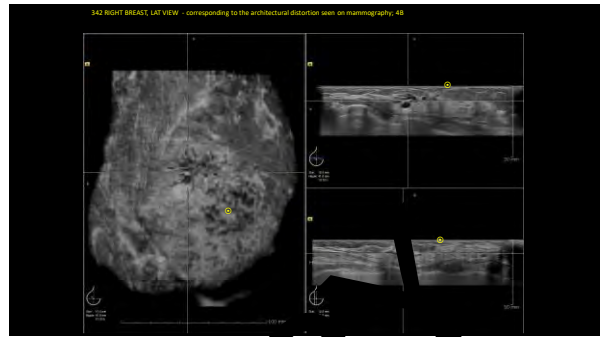
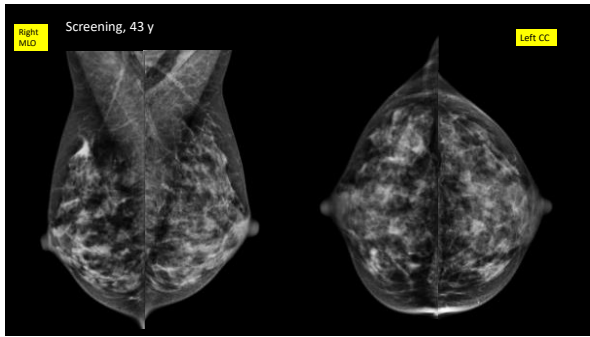
BI-RADS: Associated Features

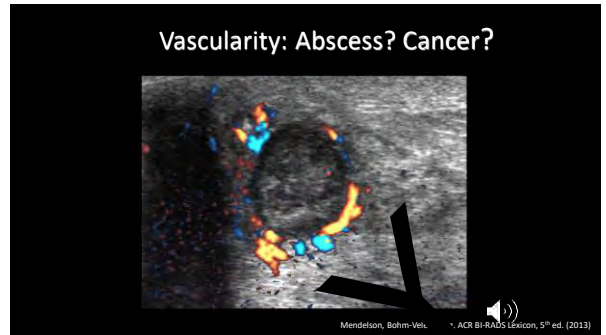
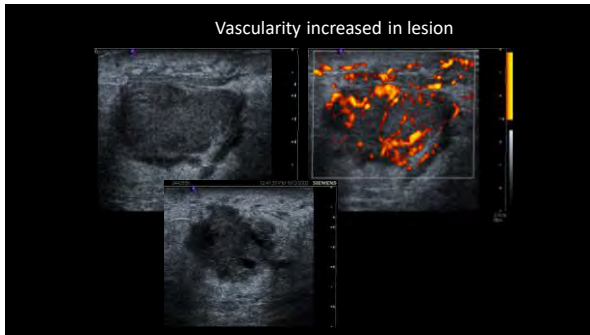
- “Non-mass findings” term borrowed from in MRI; in Asian literature (Ko KH, EJR, 2015; Zhang W, US Med Biol, 2018)
- Associated Features used in BI-RADS for Mammography; Asian countries not mammocentric
 - MRI binary: mass and non-mass mass; based on distribution
 - US has greater morphologic detail; distribution easier for AUS than HF
 - Non-mass lumping of unlike members of a set including hypochoic “areas,” calcifications, ductal changes, shadowing-essentially backwards deconstruction of BI-RADS lexicon
 - Elastography and vascularity for detection, malignancy assessment, and management
- Architectural distortion: alterations of components of breast tissue
 - Blurring of tissue planes
 - Cooper ligament straightening and truncation
 - Duct distribution, arborization, and caliber changes
 - Skin thickening, focal or diffuse
- Also within *Associated Features*: Vascularity and Elasticity



COPY

DO NOT





Applying BI-RADS in clinical practice

Feature Analysis: Masses

...ion: a mass occupies space, has volume, and should be seen in at least two US projections

Technique Tips

- Ask yourself: is the image interpretable? Does image quality meet expectations?
- Never look at only one view to make a decision
- Assess for effect on surrounding tissue before looking at mass itself
- For HH, use real-time scanning, rotating transducer to differentiate ribs and fat lobules from oval masses
- To simulate real-time, for automated at workstation, 3 orthogonal views and a rotational tool to change display from trans/sag to rad/axial
- If mass seen on whole breast scan, questions to ask:
 - Architectural distortion?
 - Solitary or multiple? Distribution?
 - Feature analysis of multiple: same or different-appearing?

Feature Analysis: Masses

MARGIN +

- Circumscribed
- Not circumscribed
 - Indistinct
 - Irregular (Echogenic rim)
 - Microlobulated
 - Angular
 - Spiculated

SHAPE+

- Oval (including macrolobulated)
- Round
- Irregular

ORIENTATION (with respect to skin)

- Parallel
- Not parallel

Feature Analysis: Masses

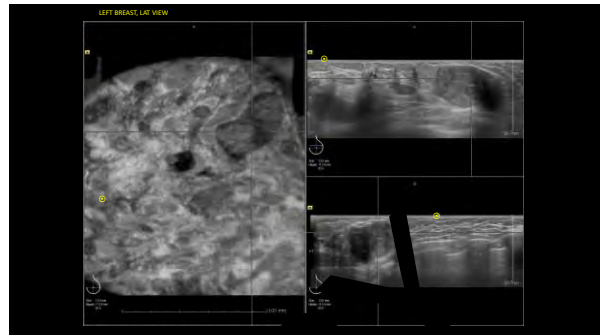
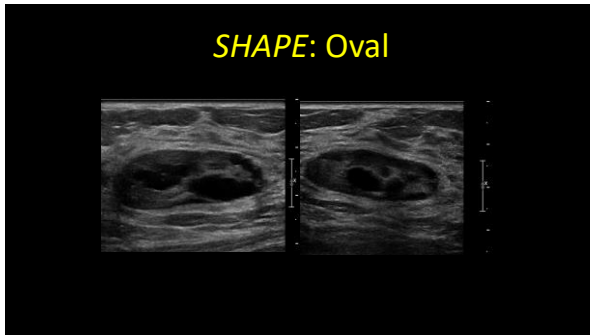
Additional Feature Categories: less specific, less predictive

Echo pattern

- Anechoic
- Hyperechoic
- Complex cystic and solid
- Hypoechoic
- Isoechoic
- Heterogeneous

Posterior acoustic features

- No posterior acoustic features
- Enhancement
- Shadowing (attenuation)
- Combined pattern



Multiple BILATERAL CIRCUMSCRIBED Masses

ACRIN 6666 data support BI-RADS 2 (benign)

Multiple bilateral similar-appearing circumscribed masses at screening US

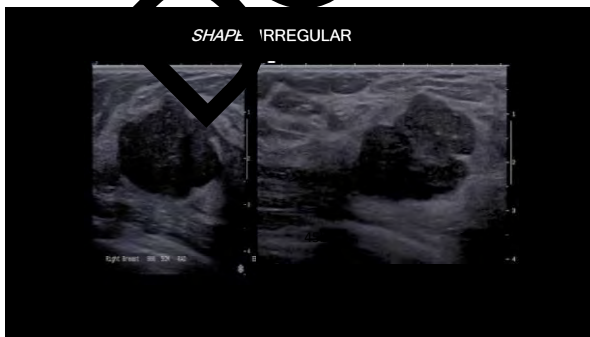
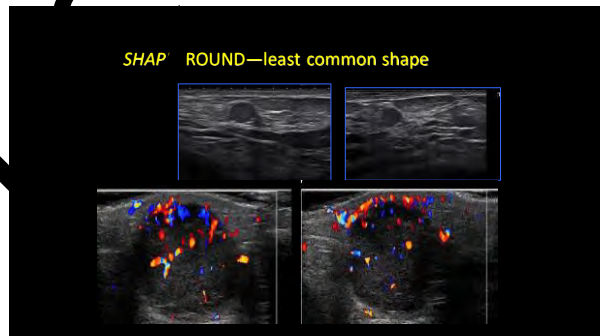
almost always benign:
 no malignancies among 127 masses found in 135/2172 participants (6.2%) with > 2y f/u

Berg, Zhang, Cormack, Mendelson, Multiple Bilateral Circumscribed Masses at Screening Breast US Consider Annual Follow-up, Radiology, 9113

If you assign BI-RAD 3, recommend annual follow-up rather than 6 months

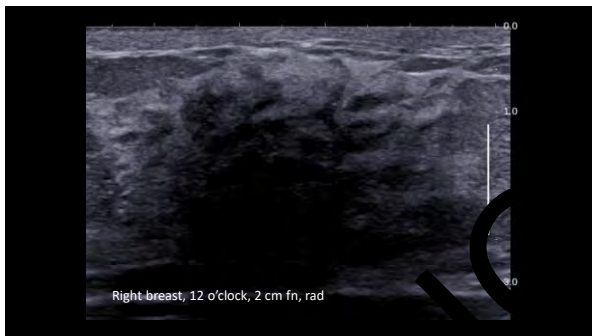
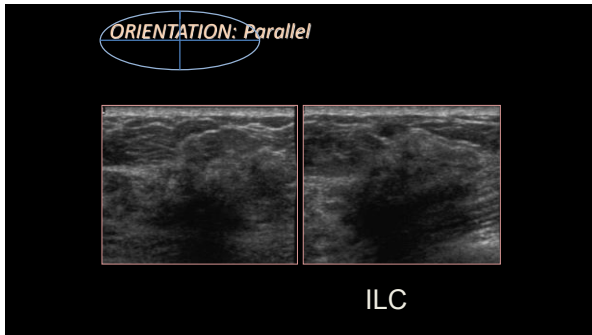
Def: Multiple bilateral = at least 3 masses, at least one per breast

Leung and Siddons, Multiple bilateral masses detected on screening mammography, AJR, 2009



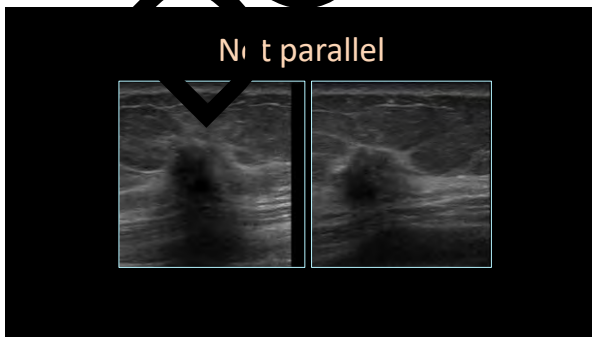
ORIENTATION

- A property of masses unique to US
- Defined with reference to the skin line.
- *Parallel* or “wider than tall” ORIENTATION is a feature of some benign masses, notably fibroadenomas but also many carcinomas
- Shape, orientation, and marginal characteristics should help dictate an assessment category



ORIENTATION

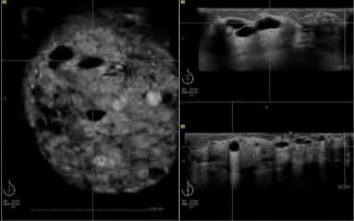
- Not Parallel
 - The anterior-posterior or vertical dimension is greater than the transverse or horizontal dimension. Synonyms: vertical or taller than wide
 - Round masses are not parallel; non-parallel masses can also be obliquely oriented.



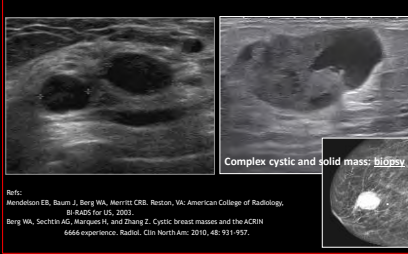
MARGIN: TWO POSSIBILITIES

The margin is the edge or border of the lesion

Circumscribed – well defined, smooth, distinct rim



“Complicated?” “Complex?”



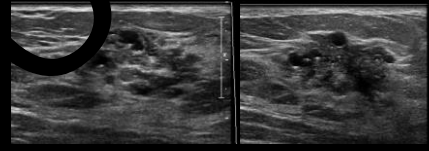
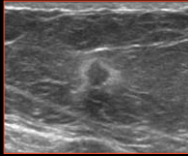
MARGIN: Two Possibilities

Not circumscribed

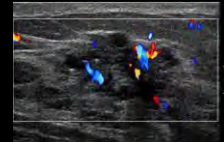
- Indistinct
- Angular
- Microlobulated
- Spiculated

ECHOGENIC (HALO) RIM HAS MOVED TO MARGIN, Not Circumscribed

Echogenic rim—no sharp demarcation between mass and surrounding tissue (*indistinct margin*): cancers and abscesses; consider form of architectural distortion



Angular - part or all margins have sharp corners or form acute angles
 BI-RADS 4C



What is your BI-RADS assessment? Management



Your BI-RADS assessment? None—you have only one view!!!

