The Bread & Butter: Diagnostic Mammography?

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SESSION 42

ABSTRACT
The diagnostic work-up of screen detected abnormalities remains the bread and butter of most mammography practices?

Rhetorical Question:
A question asked without expecting an answer but for the sake of emphasis or effect.

This Presentation, using illustrative cases, demonstrates the when, how and why of the basic diagnostic work-up of calcifications, masses and densities identified on screening mammography. BIRADS lexicon and classification is incorporated into the case demonstrations. Rationale for recommendations upon completion of work-up is discussed; when to biopsy, how and when to follow-up.
Objectives:

1. Understand the rationale for identifying and correctly classifying the multitude of types of calcifications of the breast.

2. Know the diagnostic imaging available for evaluation of screen detected masses and densities.

3. Appreciate the BI-RADS lexicon and recommendation scheme.

MY EXPERIENCE

- **Academic center**
  - Limited screening; Primarily Diagnostic

- **Private Practice**
  - High volume; numbers driven
  - Productivity monitored

- **Rural Breast Center**
  - Service to Community; Cost limitation
  - Uninsured patients

DEFINITION/PHILOSOPHY

- **Screening Mammography**
  - Reasonable risk population
  - Asymptomatic
  - Prevalence of disease
DEFINITION/PHILOSOPHY

- Diagnostic Mammography
- Screen detected abnormality
- Physical Complaint
- Follow-up
- Recent Personal Hx of treated BR Ca

PROBLEM SOLVING
Invasive Ductal Carcinoma—most common malignant neoplasm of the breast. Defined pathologically by the invasion and violation of the basement membrane of the duct. Range from microscopic to extensive. Can promote desmoplastic reaction, angiogenesis. Histological grading based on appearance, nuclear pleomorphism, and mitotic rate.

Lobar/Lactiferous Duct

Cross Section

Ductal Carcinoma In Situ (DCIS)

The entire duct may be filled with abnormal, atypical cells.

This condition is actually an early breast cancer.

Ductal Carcinoma in Situ

- extremely variable in appearance, grade, and histological pattern. Near obligate precursor to invasive disease within ipsilateral breast. Incidence has increased dramatically, largely because of mammographic screening. Rarely palpable unless advanced. Clinical outcome determined by grade, extent, and adequacy of margin resection.
IMAGING TOOLS
DIAGNOSTIC MAMMOGRAPHY

• Focal Compression
  • Mass(es), Asymmetry, Distortion
    Dissipate & Define

• Specialized views
  • Asymmetry, Distortion, Mass(es),
    Roll, Exaggerated, True Lateral

IMAGING TOOLS
DIAGNOSTIC MAMMOGRAPHY

• Magnification
  • Calcifications
    Characterize & Extent

• Targeted Ultrasound
  • Mass(es), Asymmetry, Distortion
    Define & Characterize

FOCAL COMPRESSION

• Mass(es), Asymmetry, Distortion
  Dissipate & Define
DEFINITION: MAMMOGRAPHIC MASS

- In the ACR-BIRADS, a **mass** is defined as a three dimensional structure demonstrating convex borders, usually evident on two orthogonal views.
- If seen in only one projection, a suspected mass is called an **asymmetry**.
  - Asymmetry lacks convex borders and the conspicuity of a mass.
- Due to confusion with density which describes attenuation characteristics of a mass, the term density has been replaced by asymmetry.

DEFINITION OF MAMMOGRAPHIC ASYMMETRY

- **Focal asymmetry** may be a mass obscured by overlying glandular tissue, or it may be superimposition or overlap of normal breast tissues.
- **Summation shadow** or pseudomass is the overlap of normal breast tissue.

WORK-UP OF BREAST MASSES

- **Standard views**
  - Craniocaudal
  - Mediolateral Oblique
- **Additional evaluation**
  - 90 degree lateral
  - Spot Compression, or rolled view
  - Spot Magnification
  - Ultrasound
BREAST MASS WORK-UP
Specialized Mammographic Views
a. Spot Compression
b. Spot Magnification
c. Ultrasound

Spot Compression is used to displace adjacent breast tissue and focally decrease breast thickness.

Spot Magnification is used to evaluate the border of the mass lesion.
ANALYSIS OF MAMMOGRAPHIC MASSES

- SHAPE
- Margin
- Density
- Number

SHAPE

- Round
- Oval
- Lobular
- Irregular
- Architectural Distortion

SHAPE

ROUND:
A mass that is spherical, ball-shaped, or globular in shape.
SHAPE
LOBULATED:
A mass that has contours with undulations

SHAPE
IRREGULAR:
The lesion's shape cannot be characterized by any of the above.

SHAPE
ARCHITECTURAL DISTORTION:
The normal architecture is distorted with no definite visible mass:
• Spiculations radiating from a point
• Focal retraction (puckering) of normal connective tissue lines
SHAPE
ARCHITECTURAL DISTORTION

ANALYSIS OF MAMMOGRAPHIC MASSES
• Shape
• MARGIN
• Density
• Number

MARGIN ANALYSIS OF MAMMOGRAPHIC MASSES
• Characterization of the edge or transition between a mass and the surrounding normal breast tissue
TYPES OF MASS MARGINS – BIRADS LEXICON
• Circumscribed
• Microlobulated
• Obscured
• Indistinct (Ill-defined)
• Spiculated

DEFINITION OF THE MASS MARGIN

CIRCUMSCRIBED (Well-Defined):
The margins are sharply demarcated with an abrupt transition between the lesion and the surrounding tissue.

MICROLOBULATED:
The margins appear to have many undulations.
DEFINITION OF THE MASS MARGIN

OBSCURED:
This margin is hidden by superimposed or adjacent normal tissue

INDISTINCT (Ill Defined):
The indistinct margin suggests early infiltration of breast tissue by the mass, not likely due to superimposed normal breast tissue.

SPICULATED:
The lesion is characterized by thin lines radiating from the margins of a mass
ANALYSIS OF MAMMOGRAPHIC MASSES

- Shape
- Margin
- DENSITY
- Number

DEFINITION OF MASS DENSITY

DENSITY is the degree of X-ray attenuation of the lesion relative to the expected attenuation of an equal volume of normal fibroglandular breast tissue.

MASS DENSITY

1. High density
2. Equal density (isodense)
3. Low density (lower attenuation, but not fat containing)
4. Fat containing - radiolucent. This includes all lesions containing fat such as fat necrosis, lipoma, galactocele, as well as mixed lesions such as hamartoma or fibroadenolipoma.
MASS DENSITY
High density

MASS DENSITY
Equal density (isodense)

MASS DENSITY
Low density (lower attenuation, but not fat containing)
ANALYSIS OF MAMMOGRAPHIC MASSES

- Shape
- Margin
- Density
- NUMBER

MASSES: NUMBER
Multiple similar appearing bilateral masses are almost always benign

MANAGEMENT OF BREAST MASSES

- CIRCUMSCRIBED MASSES
- Indistinct / Spiculated masses
MANAGEMENT OF CIRCUMSCRIBED MASSES

- CIRCUMSCRIBED MASS ASSOCIATED WITH FAT DENSITY
- Circumscribed mass associated with calcifications
- Circumscribed mass – no calcifications and no fat density

CIRCUMSCRIBED MASS ASSOCIATED WITH FAT DENSITY

- Oil Cyst / Fat Necrosis
- Lymph node
- Lipoma
- Galactocele
- Galactocele
- Lipoma
- Fibroadenolipoma (Hamartoma)

CIRCUMSCRIBED MASS ASSOCIATED WITH FAT DENSITY

Fat containing – radiolucent.
Imaging confirms fat density in the soft tissue mass.

CIRCUMSCRIBED MASS ASSOCIATED WITH FAT DENSITY

CIRCUMSCRIBED MASSES ASSOCIATED WITH FAT DENSITY

- Imaging confirms fat density in the soft tissue mass.

STOP

MANAGEMENT OF CIRCUMSCRIBED MASSES

- Circumscribed mass associated with fat density
- Circumscribed mass associated with calcifications
- Circumscribed mass – no calcifications and no fat density
CIRCUMSCRIBED MASS ASSOCIATED WITH CALCIFICATIONS

Coarse Calcifications
Fibroadenoma

Pleomorphic Microcalcifications-
Invasive Ductal Carcinoma

CIRCUMSCRIBED MASSES ASSOCIATED WITH CALCIFICATIONS

- Large, coarse popcorn calcifications ➔ STOP
- Milk of calcium ➔ STOP
- Microcalcifications ➔ BIOPSY
**MANAGEMENT OF CIRCUMSCRIBED MASSES**

- Circumscribed mass associated with fat density
- Circumscribed mass associated with calcifications
- CIRCUMSCRIBED MASS – NO CALCIFICATIONS AND NO FAT DENSITY

**CIRCUMSCRIBED MASS ON MAMMOGRAPHY**

- Cyst
- Fibroadenoma

**BREAST MASS WORK-UP**

Dedicated Targeted Breast Ultrasound

Important Adjunctive Procedure:
- Evaluate mammographically detected mass - Differentiate cystic from solid masses
- Evaluate asymmetry and architectural distortion seen on the mammogram
- Evaluate clinical findings - mass, thickening
- Evaluate palpable mass in women under 30 years old, in lactating, or pregnant women
WORK-UP OF CALCIFICATIONS
• ADDITIONAL EVALUATION
  • 90 degree lateral
  • Orthogonal Magnification

BIRADS CLASSIFICATION
  Morphology
  Distribution

BENIGN CALCIFICATIONS
• Skin
• Vascular
• Popcorn; Coarse
• Large Rod-Like
• Punctate Round
• Internally Lucent
• Eggshell
• Milk of Calcium
• Suture Calcifications
• Dystrophic

SUSPICIOUS CALCIFICATIONS
• Amorphous
• Coarse Heterogeneous
HIGH PROBABILITY MALIGNANCY

- Fine Pleomorphic
- Fine Linear
- Fine Linear Branching

DISTRIBUTION

- Diffuse/Scattered
- Regional
- Clustered or Grouped
- Linear
- Segmental

WORKFLOW & RESOURCE

- Screening
  - 10-15 minute time slots
  - Technologist +/- Assistant
  - Scheduling-minimal
  - Batch/Stack Interpretation
    - Immediate result decreases productivity
WORKFLOW & RESOURCE
- Diagnostic Mammography
  - 30 minutes time slot
  - Technologist +/- Assistant
  - Scheduling-maximum
  - Supervision/Interpretation
  - Result

WORKFLOW & RESOURCE
- Ultrasound
  - 15-30 minutes
  - Technologist +/- Assistant
  - Scheduling
  - Physician Intensive
    - Perform exam
    - Result

WORKFLOW & RESOURCE
- Screening
  - $200-230
- Diagnostic
  - Uni-$150-200
  - B/L-$300
- Ultrasound
  - $200-655
Feig:
- DM reimbursement rates only ~11% higher

Present rates:
- DM 30-50% higher

Resource Consumption:
- 2-3 times longer
- Greater Administrative/Technologist Time
- Greater Physician Time
SO WE BEGIN TO PONDER THE QUESTION:

The Bread & Butter: Diagnostic Mammography?

INITIATION & DISPOSITION DIAGNOSTIC PATIENTS

- SCREEN DETECTED ABNORMALITY
  - Mass or density
  - Architectural Distortion
  - Calcifications
- PALPABLE FINDING
  - Clinician and/or self discovered new palpable finding

NOT DIAGNOSTIC

- Patient cannot identify palpable abn
- Diffuse pain or tenderness
- Focal cyclic pain in absence of other physical finding
AMERICAN COLLEGE OF RADIOLOGY
MAMMOGRAPHY ASSESSMENT CATEGORIES

0: Incomplete
1: Negative
2: Benign Finding(s)
3: Probably benign
4: Suspicious abnormality
5: Highly suggestive of malignancy
6: Known biopsy – proven malignancy

An incomplete (BI-RADS 0) classification warrants either an effort to ascertain prior imaging for comparison or to call the patient back for additional views and/or higher quality films.

A BI-RADS classification of 4 or 5 warrants biopsy to further evaluate the lesion.

Some experts believe that the single BI-RADS 4 classification does not adequately communicate the risk of cancer to doctors and recommend a sub-classification scheme:

4A: Low suspicion for malignancy
4B: Intermediate suspicion of malignancy
4C: Moderate concern, but not classic for malignancy

MASS, DENSITY OR DISTORTION
- Mammographic Work-up
  - If persistent, then ULTRASOUND
  - IF ULTRASOUND is Negative???

In all likelihood, patient is designated a BIRAD 2 OR 3
MICROCALCIFICATIONS
- True Lateral
- Orthogonal Magnification

CHANGING PARADIGM
THIS IS WHERE IT GETS INTERESTING
- Mass, Distortion or Asymmetry
  - Is there anything in the Mammographic work-up that would preclude performing an Ultrasound on a persistent Mass
  - Then just go to Ultrasound
  - Ultrasound may eventually replace Mass characterization by Mammography

CHANGING PARADIGM
THIS IS WHERE IT GETS INTERESTING
- Calcifications
  - Is there anything in the Mammographic work-up that would dissuade a biopsy of highly suspicious calcifications seen on initial screening
This is where it gets interesting

- New Palpable Mass
  - Review Prior Films
  - Is there anything in the Mammographic work-up that would dissuade an Ultrasound, if previously the mammogram was negative?

Detection and classification of calcifications on digital breast tomosynthesis and 2D digital mammography: a comparison.

**Objective:** The purpose of this article is to compare the ability of digital breast tomosynthesis and full-field digital mammography (FFDM) to detect and characterize calcifications.

**Materials and Methods:** One hundred paired examinations were performed utilizing FFDM and digital breast tomosynthesis. Twenty biopsy-proven calcifications were selected for review. The calcifications were reviewed by four radiologists using a 25-point classification system. Sensitivity, specificity, and positive and negative predictive values were calculated.

**Results:** The results showed that FFDM had a significantly higher sensitivity and specificity compared to digital breast tomosynthesis (95% vs. 70%; 92% vs. 76%). However, digital breast tomosynthesis had a higher positive predictive value (90% vs. 80%).

**Conclusion:** Digital breast tomosynthesis appears to be slightly more sensitive than digital breast mammography for the detection of calcifications. However, diagnostic performance as measured by area under the curve using ROC analysis was not significantly different. With improvements in processing algorithms and display, digital breast tomosynthesis could potentially be improved for this purpose.
IN SUMMARY

If what we discussed has any credence, then your Breast Center would be better served by performing more screening Mammograms, and fewer diagnostic mammograms.

The quickest and most cost effective route from screening to biopsy passes through Ultrasound and Digital mammography, perhaps Tomosynthesis.

DIAGNOSTIC WORK-UP

Obtain Prior Films

- Most Critical, before initiating a diagnostic work-up, is comparing to prior films.
- If there is a suspect lesion, and the patient has had prior films, which are not available
  
  BIRAD 0
  
  DETAILED LETTER

DIAGNOSTIC WORK-UP

Mass, Asymmetry or Distortion

- Diagnostic Mammo +/- US
- US +/- Diagnostic Mammo
• MASS, DENSITY OR DISTORTION
  • Consider US first
  • If US suspicious, proceed to Biopsy
  • If US negative, then Mammo work-up

In all likelihood, patient is designated a BI RAD 2 OR 3

DIAGNOSTIC WORK-UP
Calcifications
• Recognize
• Characterize
• Biopsy or Follow-up

BREAST CALCIFICATIONS
SUSPICIOUS CALCIFICATIONS HIGH PROBABILITY OF MALIGNANCY

- Heterogeneous or pleomorphic (Granular)
  - Irregular, vary in size and shape
- Usually 0.2 – 0.3 mm in size
- Fine, linear, branching (Casting)
  - Discontinuous, linear distribution
  - Indicates presence in small terminal ducts

DIAGNOSTIC WORK-UP Calcifications

- If suspicious or highly suspicious on screening Mammo, proceed to Biopsy
- If indeterminate on Screening Mammo, then initiate work-up
  - 6 month follow-up
  - Biopsy
- If classically benign on screening Mammo, then resume screening

DIAGNOSTIC WORK-UP Palpable Finding

- Insure patient presents with palpable finding
- Review prior films, is the palpable finding new?
- Consider US first
Excerpt from the poem "Breast Art" by Lisa Katz.
Raphael’s La Fornarina, lives in a Roman palace now,
touching her left breast, holding it between thumb and forefinger
like a fruit she wants to prod in the market.
Perhaps the artist asked her to demonstrate
beckoning, a lover
plumping up the smaller breast
showing off in front of the mirror.
You think she’s coy.
Perhaps she wanted to touch
the lump she noticed yesterday.
Her eyes look surprised.

Palpable mass
10 o’clock LT

Patient Information

Normal mammography and ultrasonography in the setting of palpable breast cancer.

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BACKGROUND: Each year thousands of women present to general surgeons with palpable breast masses, some of which are clinically ambiguous and the majority of which are benign. In addition, surgeons are frequently faced with the question of whether to biopsy those palpable abnormalities in the setting of normal radiographic studies. One might propose that such lesions could be safely observed rather than immediately biopsied. If these lesions were not biopsied, how many cancers would escape detection? To address this issue, a population of patients with known, palpable breast cancer was retrospectively examined to determine the frequency of normal or benign findings on both mammography and ultrasonography.

METHODS: Between January 1998 and December 2001, 351 women with breast carcinoma presented initially with palpable tumors. The medical records of these remaining 351 cases were retrospectively reviewed to examine the radiographic characteristics of the palpable carcinomas. RESULTS: Of the 351 cases in the study group, 13 (3.7%) patients with palpable breast cancers had mammogram and sonogram examinations that were both normal, benign, or nonspecific in appearance. CONCLUSIONS: The results of this study indicate that nearly 4% of women with breast cancer who present with palpable lumps will have normal or benign findings on both mammography and ultrasonography. These data support prior studies of similar false negative rates and may provide some reassurance to surgeons and patients regarding clinical breast lumps, as the decision of whether to biopsy still rests in the surgeon's hands. However, inappropriate reliance on these tests for an evaluation of a palpable abnormality will result in a number of missed tumors.

Breast biopsy avoidance: the value of normal mammograms and normal sonograms in the setting of a palpable lump.

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PURPOSE: To review the authors' experience with patients who presented with breast lumps and had normal mammograms and normal sonograms. MATERIALS AND METHODS: The findings from two lumps in 46 women with no focal mammographic, US, sonor, or mammographic, findings in the area of clinical concern were retrospectively studied. Evaluated parameters included the individual reporting the lump, qualitative descriptors for the physical finding, mammographic density. US characteristics in the area of concern, whether there was a change in imaging and/or physical examination results, and whether there were diagnostic biopsy findings at follow-up. The study group included 96 lumps in 47 patients who had mammographic and clinical follow-up of 2 years, as well as 60 additional lumps in 51 patients who underwent biopsy.
RESULTS: No patient in the nonbiopsy group developed carcinoma at the initial site of concern during a mean mammographic and clinical follow-up period of 43 months, and all biopsy specimens were benign (negative predictive value, 100%).

CONCLUSION: Results of this retrospective study suggest that breast biopsy may be avoided in women with palpable abnormalities when both US and mammography depict normal tissue at the lump site.

DIAGNOSTIC WORK-UP

Palpable Finding

- US first, if suspect lesion then proceed to biopsy
- If US normal, +/- consider diagnostic mammogram
- If imaging negative, follow clinically

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FOOD FOR THOUGHT

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