Invasive Breast Carcinoma

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Outline

1. Breast Cancer: an overview of epidemiology
2. Screening guidelines for breast cancer
3. Patient #1: initial evaluation and diagnostic work-up
4. Role of diagnostic mammogram, ultrasound and MRI in evaluation of a palpable breast mass
5. Overview of image-guided biopsy procedures
6. Patient #2: initial evaluation and diagnostic work-up
7. Facts on invasive breast carcinoma
8. Summary and learning objectives
Breast Cancer: Incidence

- Worldwide, most common cancer diagnosed in women.
- Main cause of death in women aged 40-59 in the U.S.
- 210,000 new cases of invasive breast cancer diagnosed in 2010 in the United States.
- 40,000 die from the disease yearly in the U.S.
- The average lifetime probability of developing invasive disease is 1 in 8.

Breast Cancer: Mortality

- Mortality rates have declined since 1975: due to use of screening mammography, greater use and improvements in adjuvant therapies.

- In a 2002 study, Duffy et al reported a 39% reduction in breast cancer mortality when comparing the periods pre- and post-advent of population-based screening.
  - 75% of reduction estimated to be due to mammographic screening.

- Tumor stage is the most important determinant of disease outcome
- Mortality decline has been greater in women younger than age 50 (3.8%), compared to older women (2.2%) per year.

Screening Guidelines

The decision to screen a particular population is based on weighing benefits vs. costs of screening.

- **Benefits**: reduction in the risk of death as well as number of life-years gained.

- **Costs**: financial costs, costs associated with screening regimen itself (radiation risk, pain, inconvenience, and anxiety), ensuing diagnostic workup for false positive results, over-diagnosis. Cost benefit ratio also varies widely with age.
Screening Guidelines (continued)

ACR guidelines

- **Average risk:** annual screening beginning at age 40
- **High risk:**
  - BRCA1 or BRCA2 mutation carrier
  - Lifetime risk of breast cancer ≥ 20% based on family history
    - Yearly screening at age 30 but not before age 25
    - OR
  - 10 years earlier than age of diagnosis of index relative.
- **Other high risk groups:** includes women that have a history of chest irradiation between the ages 10-30, history of personal breast cancer or with dense breast tissue. These groups also warrant modified screening recommendations.

Lee, et al. *JACR* 2010
Meet Patient #1: clinical presentation

- 47-year-old healthy female who presents to her PCP due to concern about a left breast cyst that had been followed for many years.

- Recently, the area containing the cyst had become indurated and tender.

- On physical exam, her PCP noted dimpling of the left breast above the areola, along with a 3-cm firm area.

- What study did she recommend?

DIAGNOSTIC MAMMOGRAM AND BREAST ULTRASOUND
Differential Diagnosis: Breast Mass

Fibrocystic Disease or Cyst
Fibroadenoma
Breast carcinoma
Intraductal papilloma
Lipoma
Breast abscess/mastitis
Fat necrosis
Phyllodes Tumor

Appropriate Intervention:
For a palpable breast mass in a patient 30 years or older, mammography should be done first. Additionally, ultrasound following the initial radiography is recommended for further concordance with clinical findings.

Ziegfeld, CR. *Lippincott’s Primary Care Practice* 1998.
Mammography: Normal findings

Diagnostic Mammogram

- Begins with the two-view standard mammogram, supervised by radiologist.
- Additional projections, magnification, and spot compression may be used to provide better detail and disperse overlapping breast tissue to visualize suspicious findings.
- Abnormalities include spiculation, irregularity, soft tissue masses, architectural distortion, and clustered microcalcifications.

What is the role of ultrasound?

- **Screening**: used primarily as a complementary tool, to discern solid masses from cysts and increase specificity of findings.
  - Adjunct: dense breast tissue assessment, evaluation of high-risk women who cannot tolerate MRI.

- For a **palpable breast mass**: immediate US is recommended following diagnostic mammography. Can also guide ensuing intervention.
  - Ensures that palpable clinical finding corresponds with that on mammogram.

What is the role of ultrasound?

- **Sonographic evaluation of masses:**
  - Features to characterize include shape, orientation, margin, lesion boundary, echo pattern, posterior acoustic features and surrounding tissues.

- **Analysis of surrounding tissues:** evaluation of adjacent ducts, Cooper’s ligaments, tissue edema, architectural distortion, skin thickening, skin retraction and irregularity.

- **Calcifications** often diagnosed more frequently on mammogram, however vascularity pattern can be better assessed with US using Doppler.

Characteristic Findings: Ultrasound

Patient A: **oval, anechoic cyst** with enhanced posterior acoustic features and well-circumscribed margins.

Patient B: Irregular mass **with angular margins and internal calcifications**, proven to be invasive breast carcinoma.

Patient C: **Isoechoic, oval mass** found to be a fibroadenoma.

Images and text: Sedgwick, E. *Sem in Roent.* 2011
What about breast MRI?

- Higher sensitivity when screening for women > 20% lifetime risk of breast cancer.
- Evaluation of ipsilateral breast for synchronous lesions, if newly-diagnosed breast cancer is believed to be more extensive than seen on standard imaging.
- Detection of clinically and mammographically occult breast cancer in the contralateral breast after a new cancer diagnosis.
- Women with mammographically occult primary disease, in whom an adenocarcinoma of unknown primary site is identified in the axillary lymph nodes.

Our patient’s diagnostic mammogram

Images: Views of L breast CC (left) and MLO with magnification (right) shown. From BIDMC PACS

Dense breast tissue bilaterally. Spiculated subareolar 2.5 x 2.5 x 2.0 cm mass with associated calcifications noted. A 3 cm simple cyst is located posterior to the suspicious mass. A 1 x 1 cm area of suspicious calcifications noted in the LUOQ.
Dense Breast Tissue: Implications

- More complicated detection of mammographic abnormalities, and known risk factor for interval cancer after a previously benign screening exam.
- Mammographic sensitivity 80% among women with fatty breasts, but down to 30% in women with extremely dense breasts.
- Higher proportion of stromal and glandular tissue, and increased number of lesions classified as atypical ductal hyperplasia.

Dense Breast Tissue: Implications

Compared to women with less than 10% of their mammogram, women with density 75% or more are at increased risk of breast cancer.

The increase in relative risk is by a factor of 5.

Our patient’s ultrasound findings

Left breast showing 2.6 x 1.8 x 2.6 cm hypoechoic, irregular, lobulated, spiculated mass in the subareolar location corresponding to the palpable lesions. Abnormal vascularity noted on Doppler.

Images: BIDMC PACS
Our patient’s ultrasound findings

A 3.1 x 1.0 x 2.7 cm anechoic cyst was identified at the 12 o’clock position, 3 cm from the nipple. The left axilla was scanned, and benign-appearing lymph nodes were noted.

Images: BIDMC PACS
What is the next step?

Based on these findings, Patient #1’s imaging was classified as **BI-RADS 5**:

“Abnormal Finding Highly Suspicious for Malignancy. Appropriate action should be taken. Findings discussed by phone with PCP prior to proceeding with biopsy.”

From BIDMC, OMR
BI-RADS Classification

Tool designed to standardize mammography reporting, reduce confusion in imaging interpretations and facilitate outcome monitoring.

<table>
<thead>
<tr>
<th>Category</th>
<th>Assessment</th>
<th>Recommended Management</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>Assessment incomplete</td>
<td>Review prior films, obtain additional studies</td>
</tr>
<tr>
<td>1</td>
<td>Negative</td>
<td>Continue routine screening</td>
</tr>
<tr>
<td>2</td>
<td>Benign finding</td>
<td>Continue routine screening</td>
</tr>
<tr>
<td>3</td>
<td>Probably benign finding</td>
<td>Short-term follow-up mammogram at 6 months, then every 6-12 months for 1 to 2 years</td>
</tr>
<tr>
<td>4</td>
<td>Suspicious abnormality</td>
<td>Perform biopsy, preferably needle biopsy</td>
</tr>
<tr>
<td>5</td>
<td>Highly suspicious of malignancy</td>
<td>Biopsy and treatment as necessary.</td>
</tr>
<tr>
<td>6</td>
<td>Known biopsy-proven malignancy</td>
<td>Assure that the treatment is completed.</td>
</tr>
</tbody>
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Image-Guided Biopsy

# Image-Guided Biopsy

<table>
<thead>
<tr>
<th>Biopsy Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
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</table>
| Ultrasound-guided | 1. Real-time visualization of biopsy  
2. Accessibility of breast and axilla  
3. Multidirectional sampling possible  
4. Low cost, short duration, well-tolerated | 1. Can only be performed if lesion is evident on US  
2. Difficulty in confirming lesion retrieval |
| Stereotactic    | 1. Can be used for nearly all lesions visualized on mammograms  
2. X-ray of biopsy specimen can confirm that the targeted lesion was sampled | 1. No real-time visualization  
2. Breast compression required  
3. Must have arms raised  
4. Compressed breast thickness (approx. 4 cm) required for biopsy |
| MRI-guided      | Can be performed when lesions are visible on MRI but not other modalities   | 1. Transient contrast enhancement may limit ability to see lesion  
2. Difficult to confirm lesion retrieval  
3. Time consuming, expensive  
4. Weight, claustrophobia may also be limiting factors |
Our patient’s biopsy results

- Pathology showed **invasive ductal carcinoma**, grade 2, ER/PR positive, HER-2 negative, with DCIS present.
- **Microcalcifications** were noted in the left breast upper outer region
- Stereotactic biopsy would therefore be recommended if the patient chooses breast conservation therapy
Companion Patient #2: clinical presentation

- 63-year-old female who presented to her PCP for routine yearly examination, in her usual state of health.

- Her physical exam was notable for a 2-cm palpable mass in the 12:00 position of her right breast.

- There were no recent known skin changes, nipple retraction or discharge noted on history or during her physical examination.
At the site of palpable concern in the R breast, a 2.3 cm solid mass with poorly defined margins is noted.

A 9 mm poorly defined mass is also noted in the upper inner quadrant, 2.5 cm from the larger tumor.

Images: R breast MLO (left) and CC (right) views shown. From BIDMC PACS
On the R breast, at the 12 o'clock position, 2 cm superior to the nipple, a large irregular hypoechoic mass measuring 2.1 x 1.5 x 2.3 cm in size was noted. At the 2 o'clock position, 4 cm from the nipple, a second irregular hypoechoic mass was noted, likely a satellite lesion. The R axilla revealed normal-appearing lymph nodes.

Based on these findings, Patient #2 underwent ultrasound-guided core needle biopsy.

Images: BIDMC PACS
Core Needle Biopsy: results

Clips were placed at biopsied sites corresponding to the 12:00 and 2:00 lesions.

Pathology from the 12:00 position lesion was invasive carcinoma with mucinous features, grade 2, ER positive, PR negative, HER-2/neu pending.

Pathology from the 2:00 position lesion was invasive carcinoma with prominent mucinous features, grade 2, ER/PR positive, HER-2/neu pending.

Images: R breast MLO view shown.
From BIDMC PACS
Invasive Breast Carcinoma

Lobular or ductal in origin. To qualify as a special-type cancer, at least 90% of the cancerous cells must contain the defining histologic features.

Invasive Breast Carcinoma

- Invasive ductal carcinoma with productive fibrosis accounts for 80% of breast cancers. Presents with macroscopic or microscopic axillary lymph node metastases in 60% of patients.

- Almost always features a palpable mass. Nipple retraction present if central breast region involved. Lymphatic obstruction may lead to lymphedema and dermal thickening, characteristic *peau d’orange* quality.

- Multimodality of treatment employed: surgery, chemotherapy, radiation therapy and endocrine therapy are typically utilized.

- Size, histology and hormone receptor status guide treatment chosen. Therapy also influenced by disease status in the axilla, lymph nodes and/or distant sites of metastasis.

Back to our patient

- Patient #1 underwent genetic testing, given her young age and family history, to determine if she is a BRCA1 or BRCA2 carrier.

- She is contemplating between mastectomy and breast conservation for her surgical therapy.

- She is to undergo pre-operative breast MRI to further evaluate the L breast tissue, given the possibly diffuse nature of her disease.

- She will have a sentinel node biopsy to evaluate her left axillary lymph nodes for surgical planning.
## Summary: Breast Imaging Abnormalities

### Mammography

<table>
<thead>
<tr>
<th>Masses</th>
<th>Calcifications</th>
<th>Asymmetry</th>
<th>Architectural Distortion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiculation</td>
<td>Fine, linear, branching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irregular margins</td>
<td>Pleomorphic/heterogeneous</td>
<td></td>
<td></td>
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</tbody>
</table>

### Ultrasound

<table>
<thead>
<tr>
<th>Mass</th>
<th>Calcifications</th>
<th>Nipple retraction</th>
<th>Skin dimpling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ill-defined margins</td>
<td>Micro-lobulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height greater than width</td>
<td>Internal echogenicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spiculation/angulation</td>
<td>Hypervascularity at edges</td>
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Once such findings are identified, core needle biopsy is recommended. Ultrasound-guided biopsy most frequently is the chosen modality.

Summary: Learning Objectives

- Become familiar with the **epidemiology** and role of **screening** for breast cancer
- Understand the **role of ultrasound** and **MRI** as adjuncts to both screening and diagnostic mammography
- Be able to **characterize concerning breast lesions** identified on mammography and ultrasound
- Learn the **role of various imaging modalities** in the diagnostic evaluation of a suspicious palpable breast mass
References

References


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