Disclosures

No financial disclosures.
Learning Objectives

2. Evaluation and differential of breast masses in pregnant and lactating patients.
3. Discuss the presentations and considerations when evaluating palpable masses in patients under 35 years old.
Breast Imaging Evaluation in the adolescent patient*

-Sonography is the initial study of choice
  -lack of ionizing radiation
  -increased sensitivity
-Mammography reserved for targeted evaluation
  -microcalcifications
  -discrete masses in older adolescents
-MRI reserved for deep structures/chest wall masses and vascular masses

*Chung et al RG 2009
Evidence for Primary Sonographic Evaluation

- Targeted Ultrasound in symptomatic patients under 30 years old (Loving et al, AJR 2010)
  - 830 patients
  - 3 malignancies detected (0.4%)
  - Sensitivity 100%, NPV 100%

- Role of Breast Sonography in Imaging adolescents with solid breast mass (Vade et al, AJR 2008)
  - 20 girls ages 13-19, 21 masses (one had bilateral solid masses)
  - Stavros sonographic criteria used to establish benignity or malignancy mass
  - 15/21 presumed benign according to Stavros criteria, but ALL proved benign histopathologically
  - Stavros criteria was useful to predict benign masses in 65%
Normal Breast Development

- Embryonic development
  - The milk line develops from the axillary region to the groin
  - Portions regress, except at the 4th intercostal space
  - Failure to regress results in accessory tissue or a supernumerary nipple
• Thelarche
  – Appearance of breast bud
  – Usually begins age 9-10 (mean 9.8 years)
  – <8 years = premature development
  – >13 years = delayed development
• Tanner Stages
  I. Nipple elevates
  II. Breast bud develops
  III. Single mound enlarges
  IV. Second mound develops (nipple and areola above breast tissue)
  V. Areola regresses (smooth contour with rest of breast tissue)
• Tanner Stage I: Normal US prior to thelarche
  – Subcutaneous fat with heterogeneous echotexture
• Tanner Stage II: Breast bud
  – Hyperechoic subareolar tissue with central linear or stellate hypoechoic areas (developing ducts).
  – Do not mistake this for a mass. If removed, it will prevent normal development on this side.

Breast bud in a 5 year old patient. Referred to pediatric endocrinology for premature thelarche

Image courtesy of Dr. Christine Dove
**Differential Diagnosis**  
**Discrete Breast Masses in Adolescents**  
Chung et al, RG 2009

<table>
<thead>
<tr>
<th>Benign Masses</th>
<th>Malignant Masses</th>
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<td>Fibroadenoma</td>
<td>Phyllodes Tumor</td>
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<tr>
<td>Juvenile or Cellular Fibroadenoma</td>
<td>Primary breast cancer</td>
</tr>
<tr>
<td>Lactating Fibroadenoma</td>
<td>Metastatic cancer</td>
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<tr>
<td>Intraductal papilloma</td>
<td>Angiosarcoma</td>
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<tr>
<td>Juvenile papillomatosis</td>
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<td>Granular Cell Tumor</td>
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<td>Pseudoangiomatous Stromal</td>
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<td>Hyperplasia (PASH)</td>
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<td>Benign Vascular Lesions</td>
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<tr>
<td>Intramammary Lymph Node</td>
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18 year old patient with multiple palpable abnormalities in the left breast

One mass was biopsied and demonstrated fibroadenoma. Surgical excision was performed due to size of the two masses on US. Three masses found at surgery, one of which was a Phyllodes Tumor.
Fibroadenomas
Chung et al, RG 2009

• Fibroadenomas:
  – Most common breast mass in patients <20 years old
  – Many advocate conservative management. If definitive diagnosis is desired, FNA or core needle biopsy though increased risk of damage to developing structures in this age group.

• Juvenile Fibroadenomas, Giant Fibroadenomas
  – Juvenile FAs noted by rapid enlargement; typical presentation is rapidly enlarging breast. Often multiple.
  – Giant: over 10 cm
  – Generally treated with excision due to rapid growth
Phyllodes Tumors

• 1% of all breast lesions in adolescents but is the most common primary malignancy in this age group.

• Most are benign, though some are malignant
  – Difficult to differentiate even histologically
  – US findings of foci of hemorrhage or necrosis is concerning

• Most often, favorable prognosis with complete excision alone.

• Both histologically benign and malignant phyllodes may recur.
  – Increased risk of recurrence with infiltrative borders or positive margins.
  – Recurrence rate 10% in adolescents (lower than in adults)

• Malignant phyllodes may metastasize hematogenously to liver, lungs
Borderline Phyllodes

- Moderate risk of local recurrence
- Low risk of distant metastasis
- Malignant phyllodes: wide excision with either radiation or mastectomy

Image courtesy of Dr. Christine Dove
6 year old with enlarging breast mass for 1 year lateral to areola

Primary Breast Cancer

• Extremely rare

• Incidence
  – Age <19: less than 0.03 per 100,000*
  – Age 20-24: 0.2 per 100,000**

• Presents as enlarging painless breast mass

• Prognosis and management are unclear due to small number of cases

*Vade et al, AJR 2008

Retrospective review from MD Anderson

- Reviewed all patients <20 yo referred with newly diagnosed breast cancer over 40 years
- 16 patients (ages 13-19)
  - 4 phyllodes
  - 2 tumors metastatic to breast
  - 10 various forms of adenocarcinoma
    - Infiltrating ductal carcinoma
    - Secretory (juvenile) adenocarcinoma

Excluded from study

Retrospective review from MD Anderson

- Time from symptoms to biopsy: 1-13 months
- Staging at diagnosis
  - Stage I: 2 patients
  - Stage IIA: 4 patients
  - Stage IIIA: 2 patients
  - Stage IV: 2 patients
  - 0% 5 year survival rate

Metastases from non-breast primary

• May be more common than primary breast cancer in adolescents
  – Rhabdomyosarcoma
  – Neuroblastoma
  – Lymphoma
  – Ewing’s sarcoma

• Breast mass may be the presenting symptom
Sonographic appearance of metastases from non-breast primary

- Often highly cellular with no desmoplastic response
- Similar to circumscribed masses
- Not spiculated
- No echogenic halo
- Enhanced through transmission

- Only presents as bilateral masses 15% of cases
Breast Imaging in Patients under 30 years old

• Ultrasound is initial evaluation tool
  – No ionizing radiation
  – Good sensitivity and NPV (Loving et al, AJR 2010)
    • 830 patients
    • 3 malignancies detected (0.4%)
    • Sensitivity 100%, NPV 100%

• Mammography Utilization
  – Before ultrasound only in symptomatic high risk patients
  – Not routine initial modality due to radiation, decreased sensitivity in dense breasts typically seen in younger patients, and low incidence of breast cancer in this age group.
Breast Imaging in Patients aged 30-39

- ACR appropriateness criteria recommends mammography as the primary evaluation modality followed by ultrasound, if indicated
- University of Washington performed a retrospective review of patients in this age group 2002-2006 (Lehman et al, AJR 2012)
  - 1208 cases in 954 patients
  - Malignant outcomes in 1.9%
  - Advocated the use of US as primary evaluation modality in this age group with mammography as an adjunct.

<table>
<thead>
<tr>
<th>Modality</th>
<th>US</th>
<th>Mammography</th>
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<tr>
<td>Sensitivity</td>
<td>95.7%</td>
<td>60.9%</td>
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<tr>
<td>Specificity</td>
<td>89.2%</td>
<td>94.4%</td>
</tr>
<tr>
<td>NPV</td>
<td>99.9%</td>
<td>99.2%</td>
</tr>
<tr>
<td>PPV</td>
<td>13.2%</td>
<td>18.4%</td>
</tr>
</tbody>
</table>
Breast Cancer in Women under 40

- New York Presbyterian/Cornell performed a retrospective review of cancer diagnoses in young women
- Between 2007 and 2013, 52 patients under 40 years old diagnosed with breast cancer at that institution.
  - 79% presented with clinical abnormality
  - 21% diagnosed on early screening mammogram
  - 75% of the cancers had an invasive component
  - 40% had stage II or greater at time of diagnosis
  - 53% had no family history at all
  - 80% had no first degree relatives with breast cancer
  - 12% (6 pts) had BRCA mutation

23yo presented with palpable abnormality

Biopsy-proven Fibroadenoma
34yo presented with palpable abnormality

Biopsy-proven Fibroadenoma
20yo with palpable abnormality

Biopsy-proven hamartoma
27yo with palpable abnormality

Mass biopsied: invasive mammary carcinoma with extensive lymphovascular invasion

IMC was mammographically occult, likely due to breast density.
27 year old presented with palpable

MRI performed to determine extent of disease demonstrated extensive clumped non-mass enhancement throughout the left breast.
32 year old with palpable abnormality biopsied in office prior to breast imaging.
Invasive Mammary Carcinoma
Breast Imaging in Pregnant and Lactating Patients
Ultrasound

- All palpable mass that persists for more than 2 weeks during pregnancy or lactation should be evaluated with ultrasound.
  - Advantages of US:
    - Lack of ionizing radiation
    - High sensitivity in pregnancy-associated breast cancer (100% sensitivity, 100% NPV)
    - Can detect most benign masses
- Advise lactating patients to nurse or pump immediately prior to examination.

Vashi et al, AJR 2013
Mammography

• Generally safe during pregnancy and lactation with only minimal potential dose to the fetus.
  – However, should only be performed if malignancy is suspected based upon sonographic findings, physical examination, or biopsy results.

• Dose from bilateral 2-view mammogram is 0.4 mSv
  – Equivalent of 7 weeks of background radiation
  – < 50 mSv – no known teratogenic fetal effects

• Uterine Dose is Minimal.
  – In theory, lead apron may reduce the dose by 50%
  – The majority of dose is from scatter thus the utility of the apron is debatable.

Tirada et al, Radiographics 2015
Vashi et al, AJR 2013
MRI

• Contrast-enhanced MRI is contraindicated in pregnancy.
  – Gadolinium is category C
  – Gd crosses the placenta. Unknown effects on human fetus.

• Gadolinium may be safely given to breastfeeding patients
  – Gd is excreted in breast milk at 0.0004% of the systemic dose.
  – Discontinuing breast feeding not recommended. If desired only for 24 hour maximum, no contrast agent in mother after 24 hours.

• Increased enhancement due to increased vascularity making it difficult to distinguish lactation change from suspicious findings.

• Instruct patients to nurse or pump immediately prior to imaging.

  Tirada et al, Radiographics 2015
  Vashi et al, AJR 2013
  Tremblay et al, AJR 2012
Accuracy of Diagnostic Mammographic and Breast Ultrasound During Pregnancy and Lactation.

Robbins et al, AJR 2011

- Retrospective review of 155 pregnant, lactating, and postpartum patients with 164 lesions.
- 65% presented during lactation, 25% during pregnancy
- 64% presented as palpable lesion
- 40 lesions biopsied; 4 were malignant (10%)

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>NPV</th>
<th>PPV</th>
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</thead>
<tbody>
<tr>
<td>Mammography</td>
<td>100%</td>
<td>93%</td>
<td>100%</td>
<td>40%</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>100%</td>
<td>86%</td>
<td>100%</td>
<td>19%</td>
</tr>
</tbody>
</table>
Common Breast Masses in pregnant and lactating patients

**Benign Masses**
- Fibroadenoma
- Lactating Adenoma
- Galactocele
- Mastitis/Abscess

**Malignant Masses**
- Invasive Carcinoma
- In Situ Carcinoma
Fibroadenoma

- Most common benign tumor in pregnant patients.
- Likely present before pregnancy, may grow under hormonal stimulation.
- Present as new or enlarging mass. Painless, mobile, firm, and/or rubbery.
- May infarct and become painful.
- While they can demonstrate lactational change, they are distinct from lactating adenomas.

30yo with fibroadenoma present during pregnancy.
Lactating Adenoma

• Usually seen during lactation and 3rd trimester.
• Present similarly to FAs (painless, mobile, mass) and may be indistinguishable on US.
• Differ histologically from FAs. LAs contain primarily epithelial elements (secretory tubules forming aggregate lobules) and little stroma.
• LAs most often regress after cessation of lactation.

Vashi et al, AJR 2013

Well-circumscribed oval hypoechoic mass. Biopsy proven lactating adenoma.
20yo breastfeeding patient presents with bilateral masses

Aspiration proved galactoceles bilaterally.
Galactocele

- Most common benign mass in lactating women
- Most often seen after cessation of breastfeeding
- Can be seen during breast feeding and even in the third trimester of pregnancy.
- Galactoceles occur as obstruction of duct and inspissation of milk; Contains milk components: fat, protein, water, lactose.
- Imaging appearance varies significantly depending on components of galactocele, age etc.
- Natural history is spontaneous resolution. Aspiration is an option for diagnosis or symptomatic relief if necessary.

Vashi et al, AJR 2013
Galactoceles – Sonographic Features

• Acute – fat completely emulsified in water, anechoic oval shaped mass +/- septation and low level echoes

• More Chronic - lipid droplets larger, progression from echogenicity with fat fluid layer to completely echogenic to solid appearing

• Distinguishing galactoceles vs solid mass – look for blood flow and ballottement, look for echogenic milk moving to and fro with compression of transducer
Galactoceles

Chronic galactocele; Appears similar to echogenic solid mass.

Echogenic fat above anechoic fluid, water or emulsified fat

Chronic galactocele; Appears similar to echogenic solid mass.
Axillary Tail Galactocele

Accessory breast tissue in the axilla is a common location for galactoceles as the ducts in this region do not always drain to the nipple. Ducts easily become engorged with milk.
Galactocele-Mammographic Features

- Variable appearance based upon component amounts of fat, water, and proteinaceous material and chronicity

1. Acute phase - emulsified fat suspended in a watery base-water density mass

2. Subacute - large coalescent fat globules suspended in watery base still dense water density nodule

3. Mature phase - fat globules larger, unevenly distributed in watery base - “pseudohamartoma and fat fluid level”

4. Chronic galactoceles - resorption of water
Lactating Female New Palp

Images courtesy of Dr. Andrea Birch
Galactocele

Images courtesy of Dr. Andrea Birch
Pregnancy-Associated Breast Cancer (PABC)

- Defined as breast cancer diagnosed in pregnancy or within 12 months of delivery.
- Most common malignancy in pregnancy (1/3,000 to 1/10,000)
- Most common cause of cancer-related death in pregnant and lactating patient.
- Less than 4% of all breast cancers
- 10% of breast cancers diagnosed in patients under 40 years old.
- Incidence expected to increase as women delay pregnancy.

31yo presented with palpable abnormality during early postpartum period. Invasive Mammary Carcinoma.
Pregnancy-Associated Breast Cancer

• Most common presentation is a painless palpable abnormality.
  – Other presentations include unilateral breast enlargement with skin thickening, bloody nipple discharge, focal pain, or “milk rejection” by the infant on one side.

• Imaging features similar to non-gestational breast cancers.

• Often higher grade and more poorly differentiated than non-PABCs.
  – Most common histopathology is high grade invasive ductal carcinoma, ER/PR negative, with high rate of LVI.

• Unique features of PABC:
  – Larger tumor size
  – Increased rate of LVI at diagnosis

• PABC associated with a delay in diagnosis despite recent clinical examinations
  – ALL new breast masses present 2 weeks or longer require prompt evaluation.
  – Sonography sensitivity for PABC is nearly 100%.

33yo pt with enlarging mass in pregnancy. Invasive Ductal Carcinoma, ER(-), PR (-)
Delay in diagnosis carries increased risk of axillary metastases.

Studies differ on survival impact.

- Mixed results may be influenced by differences in treatment.

35yo breastfeeding patient presents with palpable mass. On MG, two areas of grouped calcifications. Invasive Mammary Carcinoma & Ductal Carcinoma In Situ.
Pregnant and Lactating Patient
Take-home points

• All new masses present for more than 2 weeks require prompt evaluation.
• Most masses are similar to non-gestational masses with the exception of lactating adenomas and galactoceles.
• US sensitivity for breast masses and PABC is near 100%.
• Mammography is safe in pregnancy and should be performed if there is a suspicious finding.
• Contrast-enhanced MRI is contraindicated in pregnancy but safe in breastfeeding patients.
• All new solid masses should be biopsied.
• Given typically aggressive PABC cancers, delay in diagnosis may have significant clinical impact.