Ultrasound and Management of the Axilla

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Objectives
- Anatomy
- Normal vs. abnormal sonographic features
- Sampling technique
- Management of patient with abnormal axilla and no known primary
- Management of axilla in breast cancer patient

Imaging axilla

Anatomy

- Technique
  - High-frequency linear-array transducer (12 MHz or 17 MHz)
  - Patient in “bathing beauty” position
  - Levels II and III not routinely scanned, but large level II nodes can be seen

- Indications
  - Vary by institution
  - Areas of axilla examined for any suspicious findings on a mammogram that is being further evaluated with ultrasound (preparation has FNR of 30-50%)
  - Palpable nodes
Normal Anatomy

- Boundaries:
  - Superior: the clavicle, scapula and first rib
  - Posterior: subscapularis, teres major and latissimus dorsi muscles
  - Anterior: pectoralis major and minor muscles
  - Medical: serratus anterior and first four ribs
  - Lateral: coracobrachialis and short head of the biceps muscle.

Published in: Jacob S. Ecanow; Hiroyuki Abe; Gillian M. Newstead; David B. Ecanow; Jan M. Jeske; RadioGraphics 2013; 33, 1589-1612

HILUM

Bedi et al. AJR 2008; 191: 646-652

FOCAL CORTICAL BULGE MAY BE EARLIEST SIGN OF METASTATIC NODAL INVOLVEMENT: TARGET FOR SAMPLING

EFFERENT LYMPHATICS: HILUM

Badi et al. AJR 2008; 191: 646-652

Benign Features

- THIN SMOOTH CORTEX
- NON-DISPLACED ECHOGENIC HILUM
- OVAL SHAPE

Feu et al. Radiology 1997; 205: 831-835

Benign Features

- THIN HYPOECHOIC CORTEX
- ECHOGENIC Z LINE
- HYPOECHOIC FATTY HILUS
- PROMINENT FATTY REPLACED HILUS
Benign Features

CASE: “Echogenic masses”

Prominent Echogenic Hila—Benign

Typically Benign

Indeterminate

Indeterminate: Mixed Features

Koeltker et al., Radiology 2008; 246 (1): 81-89

Bedi et al. AJR 2008; 191: 646-652

Symmetric: >3 mm

93% NPV - REACTIVE

* SMALL SAMPLE SIZE (6)

FOCAL THICKENING??

BENIGN - REACTIVE

POSITIVE - METASTATIC

BENIGN - REACTIVE

POSITIVE - METASTATIC
**Malignant Features**

- **MARKEDLY HYPOECHOIC**
- **ABSENT / REPLACED HILUS**
- **ROUND SHAPE**

**CASE: Enlarged nodes on mammo. Prelim US: Just cysts**

Cysts don’t occur in the axilla...

**HIV Adenopathy**

**Malignant Features**

- **FOCAL CORTICAL THICKENING**
- **DISPLACED HILUS**

**Focal Cortical Thickening: Defined**

- Deurloo et al: 2.3mm
  (Sens / Spec: 95% / 44%)
- Cinelli et al: 2.9mm
  (Sens / Spec: 86% / 77%)
- Abe et al: 3mm
  (Sens / Spec: 95% / 8%)

**Focal Cortical Thickening: Defined**

- CORTEX EQUAL TO OR GREATER THAN FATTY HILUM THICKNESS = CORTICAL THICKENING
- IMPROVED SPECIFICITY: 64%

Abe, H. et al. Radiology 2009; 250: 41-49
Overall Size?

- **BENIGN**
- **MALIGNANT**

2.59 cm
0.88 cm

NOT HELPFUL

Color Doppler

- Non-hilar (peripheral) blood flow: suspicious
- 78% PPV
- **May be useful adjunct when combined with cortical morphology**

Abe et al., Radiology 2009; 250: 41-49
Yang et al., Radiology 2000; 215: 568-573

Optimize Settings

- Round shape / replaced hilus
- Focal cortical thickening / displaced hilus
- Color doppler: non-hilar flow may be helpful
- Overall size: not useful

Summary: Node Selection

- US guided FNA
- US guided CNB

Percutaneous Sampling Techniques

- US guided FNA
- US guided CNB

US Guided FNA

- 25-87% sensitivity
- 21 or 25 G needle
- In and out quickly of the cortex of most suspicious appearing node
- With or without gentle suction
- +/- on site cytopathologist
US Guided FNA

- Tip of needle: most suspicious cortex
- Confirm cortical placement (sweep of probe, needle tip)

US Guided FNA

- **Pros**
  - Quick
  - Well tolerated
  - Minimal morbidity
  - Immediate dx if onsite cytopathologist

- **Cons**
  - Operator dependent
  - Cooperation of experienced cytopathologist
  - High FNR

US Guided CNB

- 90-94% sensitivity
- Does not require cytopathologist
- No throw device
- Open bowl advanced through node
- Cutting cannula released over open bowl

AXILLARY LYMPH NODE FNA


AXILLARY LYMPH NODE CNB

**AXILLARY LYMPH NODE CNB**

![Image of lymph node biopsy](image)

Published in: Kathryn L. Humphrey; Mansi A. Saksena; Phoebe E. Frier; Barbara L. Smith; Elizabeth A. Rafferty. *RadioGraphics* 2014, 34, 1807-1816.

**FNA vs CNB**

- Both well tolerated, minimally invasive
- **INSTITUTIONAL DEPENDENT**
  - Radiologist / Pathologist preference
  - **GOAL:** Minimize non-diagnostic and false negative results
- Our experience: CNB preferred in breast CA patients. Favor CNB in patient with enlarged nodes and no breast cancer diagnosis.

**DDx Axillary Adenopathy**

- Metastatic carcinoma
  - Breast
- Lymphoproliferative disorders
- Reactive
  - Infection, psoriasis, RA

**Axillary Adenopathy**

- **Unilateral**
  - Breast cancer
  - Reactive
  - Lymphoproliferative

- **Bilateral**
  - Systemic
  - Lymphoproliferative
Axillary Adenopathy

- **Bilateral**
  - Systemic etiology
    - Lymphoma, leukemia
    - HIV
    - Collagen vascular disease
    - TB, Sarcoid

- **Unilateral**
  - Metastatic
    - Breast
    - Melanoma
    - Lung
    - Infection/reactive
    - Silicone rupture or leak

- **BreastMRI**
  - Metastatic adenopathy, unknown primary

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Calcified Lymph Nodes

- **Coarse Calcs**
  - TB
  - Sarcoid
  - Histoplasmosis

- **Fine Calcs**
  - RA – Gold
  - Silicone (implant rupture)
  - Mets (Breast, ovarian, thyroid)

BI-RADS 2

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COVID vaccination related LAD

- Present with palpable LAD
- LAD detected on screening MG or US
- Anecdotally – Unilateral on MG
- Appearance not certain yet

<table>
<thead>
<tr>
<th></th>
<th>Onset</th>
<th>Duration</th>
<th>Dose 1</th>
<th>Dose 2</th>
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<tr>
<td>Moderna</td>
<td>2-4 days after</td>
<td>1-2 days</td>
<td>11.6%</td>
<td>16%</td>
</tr>
<tr>
<td>Pfizer</td>
<td>2-4 days after</td>
<td>10</td>
<td></td>
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SBI Recommendations

- COVID-19 vaccination status, timing and side (left vs. right arm) of vaccination.
- BI-RADS category 0 assessment to allow for further assessment of the ipsilateral breast and documentation of medical history, including COVID-19 vaccination.
- Consider a short term follow up exam in 4-12 weeks (BI-RADS category 3) following the second vaccine dose.
- If adenopathy persists after short term follow up, consider sampling.
- Scheduling screening exams prior to the first dose of a COVID-19 vaccination or 4-6 weeks following the second dose of a COVID-19 vaccination.

LAD in Non-breast CA patients

- Unilateral vs. bilateral
- Scan on contralateral side
- Careful history taking
- Sample
  - Core

The Breast Cancer Patient

- Axillary node status is primary step in staging invasive breast cancer
- Surgical and oncologic management of axilla is evolving
- Role of imaging and biopsy of axilla changing too

Anatomy: Axilla

I: Lateral
II: Posterior
III: Medial
Relative to Pectoralis Minor

Background

- Axillary lymph node status
  - Determine prognosis (along with tumor size)
  - Most important prognostic indicator for survival
    - Nodal mets DECREASES 5 yr survival by ~40%
  - Decide on appropriate treatment
    - Guides oncologic and surgical management
    - Need for systemic chemotherapy and RT
Axillary Nodes in Breast Cancer

Intramammary nodes in the axillary tail are not considered to represent axillary metastases.

Background

- 1975
  - Radical mastectomy

- 1975-1995
  - BCT and ALND

- 1995-2011
  - SLNB
  - 2011-

1974: NSABP B-04

- Randomized radical (AD) vs. total + nodal XRT vs. total mastectomy
- No difference in survival at 10 years if nodes were clinically negative
- BUT...axillary dissection continued as standard procedure for prognostic info and for management decisions


1995-2011 Surgical Staging

- SLNB replaced ALND as initial method of staging the axilla

- If SLNB +, ALND performed for complete staging and local control

- US axilla with FNA/core bx of abnormal nodes = straight to ALND if +
Background

**Standard staging: SLNB**
- Lower morbidity
- Low false negative rate ~ 10%
- Clinically node negative patients
- Removal of first draining node from a regional node basin
- If negative, remaining nodes presumed negative.

**Background: SLNB**
- Radiolabelled injection hours before surgery: Peri-areolar or Peri-tumoral
- Pre-operative gamma camera imaging
- Intra-operative node detection / excision

**Background: SLNB**
- SLNB Limitations
  - Time consuming
  - Technically challenging
  - Adds cost if positive
  - Requires additional OR and anesthesia time
    - Positive frozen section - subsequent ALND
    - Second OR trip for post-operative positive results

**Background**
- Late 1990’s - 2011: **PRE-OPERATIVE AXILLARY STAGING MOST USEFUL MEANS TO STAGE AXILLA**
- Informs (individualizes) patient management:
  - Neo-adjuvant chemotherapy / treatment protocols
  - Surgical planning

**Role of Imaging**
- Imaging preoperatively determines lymph node involvement in non-palpable lymph nodes to determine upfront which patients may need ALND and obviate SLNB in these cases.
- Assess response to therapy
- Samples, map, localise

**Impact on Management**

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>FNR</th>
<th>FPR</th>
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</thead>
<tbody>
<tr>
<td>SLNB</td>
<td>88.7%</td>
<td>100%</td>
<td>11.3%</td>
<td>0</td>
</tr>
<tr>
<td>USNB+SLNB</td>
<td>97.2%</td>
<td>100%</td>
<td>2.8%</td>
<td>0</td>
</tr>
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Wang et al., BMC Cancer, 2015
**Background**
- Axillary surgery definitive test to determine neg axilla
- Goal of pre-op imaging is to identify nodal mets with PPV high enough to be useful to surgeon to decide to go directly to ALND.
- If false+ findings lead surgeon to perform unnecessary ALND or ambiguous findings result in too many neg percutaneous biopsies, then axillary imaging will be irrelevant or harmful.
- Need to understand normal and abnormal appearance of LN and accurate pre-op sampling

**ACOSOG Z0011**
- **Axillary Dissection vs No Axillary Dissection in Women With Invasive Breast Cancer and Sentinel Node Metastasis**
- A Randomized Clinical Trial

- **ACOSOG Z0011**
  - T1-T2 IC, 1-2 + SN
  - Lumpectomy with neg margins, whole breast XRT, + adjuvant therapy
  - Randomized to ALND vs. no ALND
  - Median 6 years follow up
  - No survival difference between groups

- **ACOSOG Z0011**
  - Planned accrual: 1900 patients
  - Trial closed early (2004) due to slow accrual and low event rate
  - Locoregional recurrence: F/U 6.3 years
    - ALND (4.1%), SLND (2.8%) P=0.11
  - Overall survival (5 years)
    - ALND (91.8%), SLND (92.5%) P=0.25
  - Disease free survival (5 years)
    - ALND (82%), SLND (83.9%) P=0.14

- **ACOSOG Z0011**
  - No difference in overall and disease free survival between study groups
    - Overall survival (5 years)
      - ALND (91.8%), SLND (92.5%) P=0.25
    - Disease free survival (5 years)
      - ALND (82%), SLND (83.9%) P=0.14

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**February 8, 2011**

“The Lymph node study shakes pillar of breast cancer care”

“...for node + women who meet certain criteria, taking out cancer nodes has no advantage”

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**The New York Times**

February 8, 2011

“Lymph node study shakes pillar of breast cancer care”

“...for node + women who meet certain criteria, taking out cancer nodes has no advantage”
ACOSOG Z0011: Conclusions

- SNLD alone provides excellent locoregional control in select patients
  - Non-inferiority to ALND
- Applicability:
  - T1 or T2, 1-2 +SN
  - Treated by lumpectomy + whole breast XRT, +/- adjuvant systemic therapy

ACOSOG Z0011: Conclusions

- Results DO NOT apply to patients:
  - With 3+ nodes, matted nodes, extracapsular spread
  - Clinically positive (palpable) nodes
  - T3 or T4 tumor
  - Partial breast radiation
  - Treated with mastectomy
  - Neoadjuvant chemotherapy

So do we still perform axillary US and US bx in early stage breast cancer?

- Yes
  - Not fitting Z0011 criteria
    - T3-T4 tumors, T1-T2 going directly to mastectomy, NAC
    - It depends on surgeon preference, patient preference (BCT vs. mastectomy, what type of XRT)
    - TJUH: surgeons still want imaging and bx if abnormal
    - To identify LN that might cause “tumor damming”, false neg SLNB
    - Document 3 or more grossly + nodes
    - Document higher level axillary nodes (level 2 and/or 3)
    - Identify perinodal invasion
    - Identify abnormal IM lymph nodes

Impact on Management

1. Avoid sentinel lymph node biopsy, redirect to ALND immediately: 33% (8-26% for FNA) (19.8 for all UNB)
2. Reduce re-operation for axillary dissection
3. Early identification of neoadjuvant candidates
4. Accelerates time to adjuvant therapy by as much as 25.7 days
5. Immediate reconstruction offered (adjuvant not anticipated – mastectomy and negative CNB) in 35.1%
6. Identify other malignancies/pathology

ACOSOG Z1071

- NAC eradicates nodal disease 40-75%
- NAC and SNB
  - FNR 12.6%
  - Lower in patients both tracer and dye and >2 nodes retrieved
  - 6.8% if clipped node retrieved

Targeted Axillary Dissection after NAC


https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4069800/
https://hal.archives-ouvertes.fr/hal-00668067/document
https://www.sciencedirect.com/science/article/pii/S2211568412002392#bib0175

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Targeted Axillary Dissection
- Localization of the clipped node for TAD reduced the FNR of SLNB in setting of NAC
- Radiograph axillary specimen to identify clipped node
- Decrease FNR compared to SLNB alone
  - SLNB 10.1% vs clipped node 4.2%
  - TAD 2% (both SLNB and retrieve clipped node)

Role of Radiologist
- Clip node at time of bx
- Put clip in cortex
- Use clip you can see under US

Role of Radiologist
- Localize node
  - Wire localization
  - Radioactive seed
  - Tattoo ink
  - SPIO (superparamagnetic iron oxide)
  - Magnetic (SPIO) clip
  - Reflector clip
- Specimen radiograph
Axillary Management Is Evolving
- Radiology continues to have important role in axillary management
- Need to work closely with your surgeons, oncologists, radiation oncologists
- Factor in patient’s wishes
- No clear cut answer, different surgeons may take different approaches

Summary
- Axillary node status is important for determining prognosis in breast cancer patients
- Management of the axilla has become less and less surgically invasive over the past several decades

Summary
- Communication between radiologists and other members of patient care team is key to ensure appropriate use of imaging and biopsy in the axilla
- Axillary sampling still maintains an important role in management of certain patients
- Knowledge of suspicious features and Bx technique is important for successful node sampling.
Thank you!

Questions?