Ultrasound Guided Percutaneous Breast Biopsy and Fine Needle Aspiration

Advantages of Image Guided Percutaneous Breast Biopsy

• Accurate pathologic diagnosis
• Accurately targets abnormality for image detected as well as palpable findings
• Minimally invasive
  - minimizes surgery and morbidity
  - no surgery if benign
  - one surgery if malignant (lumpectomy)

Advantages of Image Guided Percutaneous Breast Biopsy

• Minimizes patient inconvenience
• Minimizes cost (surgical biopsy can cost up to 5X as much)

History of percutaneous biopsy

• By 1914, needle aspiration biopsy used for lung and lymph nodes
• With increased use of mammography:
  - 1970’s: Stereotactic device introduced
  - 1980’s: Automated core biopsy guns, paired with US and stereotactic imaging

Methods of Guidance for Percutaneous Biopsy

• Palpation
• Stereotactic
• DBT Guided
• Ultrasound
• MRI

Stereotactic Biopsy
Technical Considerations - Stereotactic Biopsy

- Compressed breast thickness, breast size
- Abnormality must be able to be placed in window (deep lesions and superficial lesions may not be able to be adequately visualized)
- Abnormality must be well visualized on work station monitor
- Weight limit for prone tables

MRI GUIDED BIOPSY

Ultrasound Guided Aspiration or Biopsy - Advantages

- Utilizes existing equipment
- Quick procedure (20-30 minutes, biopsy takes 1 minute)
- Comfortable position for most patients
- Able to survey remainder of the breast and axilla and biopsy additional masses as necessary

Ultrasound Guided Fine Needle Aspiration

- Symptomatic Cysts (painful)
- Suspected Abscess (correlate with history/symptoms/physical exam)
- Axillary Lymph Nodes
- Solid breast masses when core biopsy not feasible or available

US Guided Core Biopsy

- Complex cystic and solid masses (BIRADS 4-5)
- Calcifications that correlate with suspicious mammographic finding
- Axillary lymph nodes

Radiologyinfo.org

US Guided Core Biopsy
Ultrasound Guided Biopsy Equipment - Options

- Spring Loaded/ Vacuum Assisted/Combination
- Disposable/Non Disposable
- Single Pass/Multiple Pass
- Sample Collection – single sample vs aggregate of all samples
- Portable/Console
- Multimodality Capability (Stereo,MRI)

Biopsy Devices

- Spring Loaded- 14G
  - Advantages
    - Less expensive
    - No bulky equipment
    - May be better for small masses
    - pts with bleeding disorders
  - Disadvantages
    - May need more specimens to ensure sampling

- Vacuum-Assisted-8-12G
  - Advantages
    - Larger cores
    - Complete sampling in fewer passes
    - May remove entire lesion
  - Disadvantages
    - More expensive
    - Bulky equipment

Accuracy - had to be proven

14 Gauge core needle, 1352 cases (2008)

- 98.5% sensitivity
- False negative 1.6% (all identified prospectively)
- 6% were high risk lesions requiring excision (31% upgraded at excision)


Relative Size of Specimens

11 g vacuum assited vs 14 g core biopsy specimens

Preparation

Screen for:
- Anticoagulant use
- Bleeding disorder
- Allergies/sensitivities
Preparation

Review imaging and reports
- how many masses have been recommended for biopsy and/or follow up
- size, shape and location of mass
- surrounding parenchyma – dense or fatty
- size of breast

Informed consent
Describe procedure
- describe alternative diagnostic methods
- describe known complications
  - Bleeding, infection
  - High risk lesion requiring excision
  - Sampling error
  - Clip placement
- allow patient to ask questions

Patient Positioning
- Supine or semi upright, flat or oblique
- Ipsilateral arm raised over head
- Change position to achieve best approach
  - Area of interest should be
    - As accessible as possible
    - As comfortable as possible for you
- Make patient as comfortable as possible

Preparation - Imaging
- Pre-scan the patient
- Image and label – 2 orthogonal planes
- Determine the best approach
  - Consider
    - Location of lesion
    - Relation to chest wall
    - Tissue density/firmness
    - Comfort

Procedure tray
- Skin cleansing solution
- Sterile drape
- Sterile probe cover
- Sterile gel or iodine solution as coupling agent

Core Biopsy Technique
- Cleanse skin, drape if necessary
- Consider location of skin nick
  - avoid upper inner quadrant
  - approx. one inch from transducer, farther away for deeper lesions to maintain parallel approach
- Skin Nick - 11 blade
Local Anesthesia

- 1% lidocaine w/wo bicarbonate for superficial
  1-3 cc superficially at needle insertion site, 25 g needle

- xylocaine (2% lidocaine and epinephrine) for deeper
  up to 10 cc along anticipated biopsy track, 20 g spinal if needed
  Image during injection of anesthetic in order to confirm best parallel approach

Image while administering deep lidocaine

- Observe/test approach
- Observe post lidocaine appearance
- Confirm adequate infiltration of biopsy track
- Too much lidocaine can obscure small masses

Positioning of the Needle: Longitudinal approach

- Entire length of needle should be visible under the long axis of the transducer
- Needle path ideally approaches a parallel course relative to chest wall
  - To best visualize the needle
  - To avoid chest wall trauma and pneumothorax
Spring Loaded Core Biopsy – how it works

Automated Spring Loaded Core Biopsy

- Image target
- Aim at target
- Deploy device
  - Fire gun
  - Confirm post fire location
  - Most accurate assessment with 2 views: long axis and orthogonal views
- Acquire tissue
- Repeat as necessary

Post-Fire: mass and tissue may shift

Re-assess position of needle in 2 views

Long axis view may not confirm that needle is in mass
Short axis view confirms needle in mass

Recording Images

- Pre-biopsy – mass in 2 orthogonal planes
- Pre – biopsy – Pre fire
- Post Biopsy – Post fire

Vacuum Assisted Device – how it works

- Place cutting needle in or under mass
- Sheath retracts and mass is suctioned into sample chamber and back through needle into collecting container
- Sheath covers sample chamber
Automated Vacuum Assisted Core Biopsy TECHNIQUE

- Image target
- Aim at target
- Place device within or under target
  - Confirm position of needle tip and collecting chamber
  - Most accurate assessment with long axis and orthogonal views
- Open specimen chamber (push sample button)
- Acquire tissue
- Repeat as necessary
Recording Images

• Pre-biopsy - mass in 2 orthogonal planes
• Post biopsy - long axis of needle in tissue acquiring position

After Sampling

• Remove needle
• Remove specimen from needle or collecting chamber
• Place specimen in formalin container
• Repeat for desired number of specimens
• Place post biopsy marker clip

Clip Placement

• To mark site of biopsy
  – for future localization in cases of malignancy
  – to define area of biopsy for future follow-up imaging
  – mass may have been completely removed at biopsy
• To mark site of cancer treated with neoadjuvant chemotherapy
• Gel based/titanium visible on US, mammo, and MRI
After Clip Placement
- Hold pressure (5-10 minutes)
- Steri strips on skin nick; gauze pressure dressing or elastic wrap, may need ice
- Post biopsy mammogram

Document in Report
- Informed consent
- Details of procedure
- Complications
  - If clip on post biopsy mammogram is in the expected biopsy location, if not, how many cms/mms away
  - If there is residual lesion
  - Pt given post procedure instructions
  - Path pending – addend report

Needle Visualization
- Linear objects produce brighter echoes when insonated perpendicular to the US beam

Post-Biopsy Care
- Steri-strip on skin nick
- Pressure dressing
- Ice pack
- Keep area dry
- Avoid strenuous activity for 24-48 hours
- Watch for excessive bleeding, pain, fever

Challenges in US guided breast biopsy
- Visualizing needle
- Lining up needle and target
- Creating and maintaining safe approach along chest wall
- Confirming accurate position after sampling
- Pathology correlation
Longitudinal Approach

Standard, safer approach

Ideal longitudinal approach

Approach too steep

Approach too steep
Ideal Needle Placement

entire mass/target in view
entire long axis of needle

Ultrasound image

Bird’s eye view

If you cannot see the entire long axis of the needle and the mass in your image, your needle or transducer may be askew - angled off of target

or your transducer may be tilted off of plane of the target

Needle Askew

transducer over target
entire mass in view

partial long axis of needle in view

Ultrasound image

Bird’s eye view

If your needle is askew…

Look at your hands
Note orientation of needle to transducer

Rotate and position needle under and parallel to the transducer

Transducer askew

transducer over target
entire long axis of needle in view

partial mass in view

Ultrasound image

Bird’s eye view

Look at your hands
Note orientation of transducer to target

Rotate transducer to see mass

Rotate and position needle under the transducer
Pathology Correlation

Imaging-Histologic Discordance

Benign result for suspicious lesion

- 0.9-6.2% percutaneous biopsies
- 24.4% rate of malignancy
- “if the shoe doesn’t fit”

Pathology Correlation

High Risk Lesions

- Flat Epithelial Atypia
- Atypical ductal hyperplasia (ADH)
- Atypical lobular hyperplasia and lobular carcinoma in situ (LCIS)
- Mucocele like lesion
- Papillary Lesions - typical and atypical
- Radial scar

Pathology Correlation

Image-Histologic discordance at percutaneous breast biopsy: An indicator of missed cancer. 2000
Laura Liberman M.D.,†,*
Michele Drotman M.D.,†
Elizabeth A. Morris M.D.,†
Linda R. LaTrenta M.D.,†
Andrea F. Abramson M.D.,†
Maureen F. Zakowski M.D.
and D. David Dershaw M.D.

Pathology Correlation

High Risk Lesions

- Flat Epithelial Atypia
  - cytoplagic atypia of luminal epithelial cells
  - calcifications common abnormal finding (mammogram)
  - can be associated with low grade DCIS, lobular neoplasia, or IDC or ILC
  - 0-30% upgraded to DCIS/IDC
  - if all calcs/findings was entirely removed – for possible follow up
  - surgical excision/surgical consultation
Pathology Correlation
High Risk Lesions

Atypical Ductal Hyperplasia
• atypical epithelial cells partially or completely filling duct
• involving 1 or 2 ductal spaces measuring 2 mm or less
• at least 30% upgrade rate
• Surgical excision

Pathology Correlation
High Risk Lesions

Atypical Lobular Hyperplasia and LCIS
• young women, bilateral and multifocal
• calcifications/mass
• upgrade 0-67%
• Surgical excision – studies ongoing when result is incidental

Pathology Correlation
High Risk Lesions

Mucocele like Lesions
• solid mass, complex cyst and/or calcs
• epithelial lined mucin filled spaces
• epithelium may be benign, atypical, malignant
• Surgical excision/consultation if not benign

Pathology Correlation
High Risk Lesions

Papillary Lesions
• palpable or nipple discharge
• mass, intracystic or intraductal – fibrovascular stalk
• benign, atypical, malignant
• upgrade benign 0-36% (14 G needle)
• Surgical excision atypical or malignant
•consider follow up if benign or if papilloma entirely removed/surgical consultation

Pathology Correlation
High Risk Lesions

Radial Scar
• radial sclerosing lesion/complex sclerosing lesion
• central sclerosis surrounded by epithelial proliferation – benign to malignant
• upgrade 0-12%
• malignant involvement of radial scar may be focal or patchy
• Surgical excision

Pathology Correlation
High Risk Lesions

Multidisciplinary Considerations in the Management of High-Risk Breast Lesions
Savitri Krishnamurthy1, Therese Bevers2, Henry Kuerer3 and Wei T. Yang4
AJR. February 2012, Volume 198, Number 2
Pathology Correlation
High Risk Lesions

- Flat Epithelial Atypia - excision
- Atypical ductal hyperplasia (ADH) - excision
- Atypical lobular hyperplasia and lobular carcinoma in situ (LCIS) - excision
- Mucocele like lesion - atypical/malignant - excision
- Papillary Lesions - atypical - excision
- Radial scar - excision

ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF ULTRASOUND GUIDED PERCUTANEOUS BREAST INTERVENTIONAL PROCEDURES

Results of ultrasound-guided as well as other imaging guided percutaneous breast interventional procedures should be monitored. The following records should be maintained for the facility, practice, and individual physicians:

1. Total number of procedures.
2. Total number of cancers found.
3. Total number of benign lesions.
4. Total number of ultrasound-guided biopsies needing repeat biopsy, categorized by reason and type of biopsy (i.e., CNB, FNA)
**Summary:** Image guided percutaneous breast biopsy

- Standard of care for minimally invasive diagnosis of breast abnormalities
- 98.5% sensitivity, 1.6% false negative (compares with surgical excision)
- Requires expertise in image modality and biopsy techniques, path correlation
- With careful technique and correlation, minimal morbidity for both benign and malignant diagnosis

---

**Pitfall of needle visibility:**
Needle track from previous sample, not to be confused with actual needle during next pass

---

**Creating and maintaining safe approach along chest wall**

---

**Tricks to maintain safe longitudinal approach while minimizing length of needle course through tissue**

---

**Limiting Distance of Needle Excursion**

- Think of needle as a lever
- Take advantage of the malleable nature of the breast
Parallel to chest wall but far from mass

Start closer to mass but too steep

Advance part way to mass then lever needle into parallel course

Keep pressing down (gently)

Keep pressing down (gently) till needle is near parallel to chest wall

Then biopsy
Confirms accurate sampling of target

Why re-assess needle position?
Pre-fire: perfect position
Post-fire may still miss

Needle motion can shift mass and tissue during firing
Pre-fire
Post-fire
Mass shifted to the side when the needle fired
Mass and needle can volume average in US image and appear to be successful biopsy

Need orthogonal view to confirm needle location in mass
US image shows needle apparently in mass
Needle next to mass, volume average in image

Aim at target
Deploy device