Percutaneous Lung Biopsy in the Molecular Profiling Era
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Objectives

- Evaluate the role of percutaneous lung biopsy in the molecular profiling era
- Apply various techniques that can be utilized during percutaneous lung biopsy to improve the chances of success and limit complications

Emerging indications

- Small (subcentimeter) nodules
- Ground-glass opacities
- Tumor detection following treatment
- Molecular/genetic analysis
- Clinical trial enrollment

Disclosures

- None

Percutaneous lung biopsy

- Well-established minimally-invasive method for the assessment of suspicious or indeterminate lung lesions
- Traditional goal is to obtain sufficient tissue to render accurate pathologic diagnosis

Sharpe et al. JACR 2013;10:770-773

The Increasing Role of Radiologists in Thoracic Diagnosis: More Thoracic Biopsies Are Performed Percutaneously
### Biopsy techniques

- **Fine needle aspiration (FNA)**
  - Aspirating cells for cytologic and morphologic analysis
- **Core needle biopsy (CNB)**
  - Obtaining fragments of tissue for histologic and architectural assessment

### Core needle biopsy vs FNA

- **Highly accurate in all practice settings**, including those in which on-site cytology not available to assess FNA specimens
- **Lower false negative rate** for diagnosing malignancy
  - 96% vs 77% accuracy
- **Favored in diagnosis of nonepithelial malignancies** (e.g., sarcoma, melanoma): 92% vs 40% accuracy
- **Superior to FNA in diagnosing benign lesions**: 92% vs 40% accuracy


### CNB – immunohistochemistry

- **More tissue available for immunohistochemical tests**, which can provide more specific diagnostic information
  - Distinguish between primary and metastatic carcinoma
  - If metastatic disease, identify primary neoplasm

Zamecnik et al. Virchows Arch 2002;440:353-361

### CNB – molecular profiling

- **With increasing advances in molecular analysis and targeted therapy**, greater amounts of tumor tissue needed to identify various somatic mutations
- **Molecular phenotyping** → **prescribe targeted therapy**
- **Personalized treatment of pulmonary neoplastic disease**
**CNB – molecular profiling**

- Genetic mutations in lung adenocarcinoma
  - EGFR (epidermal growth factor receptor)
  - KRAS (Kirsten ras viral oncogene homolog)
- EGFR and KRAS predict survival rate
- EGFR tyrosine kinase inhibitors
  - Erlotinib (Tarceva), gefitinib
- EGFR positivity → improved response rate
- KRAS positivity → lower response rate

2. Solomon et al. AJR 2010;194:266-269

**Underratilization of CNB**

- Despite advantages of CNB, many radiologists still prefer to biopsy lung lesions using FNA
- STR survey 2005: 3 cm peripheral mass
  - FNA favored by 73%
  - CNB favored by 14%
  - FNA+CNB favored by 13%


**CNB – technique**

- 20-gauge semi-automatic cutting needle inserted through a 19-gauge coaxial introducer needle
- Minimum of 3 quality core samples for complete molecular/genetic analysis

**CNB – challenges**

- Theoretical increased risk of pneumothorax due to larger-gauge cutting needle employed, compared to smaller-gauge aspiration needle
- Increased risk of lacerating adjacent vessels, which may cause major hemorrhage
- Vessel laceration increases risk of air embolism

**Tips and tricks**

- Patient positioning
- Intravenous contrast
- Breath-hold technique
- Pleural anesthesia/wheel
- Tangential approach for peripheral lesions
- Needle manipulation for deep lesions
- Autologous blood patch
- Pneumothorax management
Patient positioning

- Avoid decubitus position if possible
  - Increased respiratory excursion and ventilation of lung being biopsied
- Prone position with internal rotation of arm and towel roll under lateral chest for lesions behind scapula

Breath-hold technique

- Importance of patient cooperation
- Same-sized breath prior to scan or needle adjustment
- Small-to-medium sized breath easier to replicate
- If the patient cannot breath-hold, advance needle during same phase of quiet respiration
Pleural anesthesia

- Adequate pleural anesthesia to prevent sudden movement or change in breath-hold when entering lung
- ~5 cc 1% lidocaine within the extrapleural fat

Ko et al. Radiology 2001;218:491-496
Wallace et al. Radiology 2002;225:823-828

Pleural anesthesia/wheal

Tangential approach for peripheral lesions

- Tangential approach creates shallower pleural puncture angle, associated with increased pneumothorax rates
- For small subpleural lesions, tangential approach is more accurate
  - Direct approach may result in outer cannula slipping into pleural space during respiration

Needle repositioning for deep lesions
**Autologous blood patch**

- Inject patient’s own partially clotted blood through outer cannula as it is withdrawn to create parenchymal and pleural seal
- Associated with decreased pneumothorax rates, particularly extremely low rates of pneumothoraces requiring intervention

Lang et al. Radiology 2000;216:93-96
Malone et al. AJR 2013;200:1238-1243

**Pneumothorax management**

- If sizeable pneumothorax, withdraw coaxial outer cannula into pleural space and manually aspirate air
  - Can obviate chest tube placement¹
  - Intrapleural blood patch following aspiration may further reduce need for chest tube placement²

¹Yankelovitz et al. Radiology 1996;200:695-697
²Wagner et al. AJR 2011;197:783-788

**Conclusions**

- In the molecular profiling era, radiologists who perform lung biopsies should incorporate CNB technique
- By applying the concepts and techniques in this presentation, radiologists can increase their chances of success while limiting complications
References


