Dr. Samir Makani is an Associate professor of Medicine and the Director of Interventional Pulmonology and Bronchoscopy at the University of California, San Diego. He completed his Pulmonary and Critical Care fellowship at the University of California, San Diego followed by a fellowship in Interventional Pulmonology at Henry Ford Hospital in 2009.

**OBJECTIVES:**

Participants should be better able to:

1. Gain knowledge and understanding of Navigational Bronchoscopy including its applications and limitations;

2. Gain knowledge and understanding of endobronchial ultrasound including advanced applications of lung mass fine needle aspiration and fiducial placement.
ADVANCES IN PULMONARY DIAGNOSTICS

Samir Makani, MD, FCCP
Director, Interventional Pulmonology
Associate Professor of Medicine
University of California, San Diego

DISCLOSURES

• Consultant for Covidien 2015
• Consultant for Olympus 2015
• Consultant for Carefusion 2015
OBJECTIVES

• What is Interventional Pulmonology?

• Advances in Pulmonary Diagnostic Procedures
  – Endobronchial Ultrasound
    • Linear / Peripheral Ultrasound
  – Navigational Bronchoscopy

Interventional Pulmonology

• Pulmonary physicians specializing in advanced bronchoscopic and pleural techniques

• As my wife refers to me.. “Pseudo-Surgeon”
ENDOBRONCHIAL ULTRASOUND

Beyond Lymph Node Staging

BACKGROUND

• Lung Cancer remains the #1 cause of cancer related death worldwide

• Appropriate staging of lung cancer is important as it guides treatment options

• Mediastinal lymph node sampling is essential for adequate staging and avoiding unnecessary thoracotomy
**MEDIASTINAL LN ANATOMY**

- Ipsilateral Hilar LN
  - 10, 11, 12
- Stage IIA - IIB
- Surgical

- Ipsilateral Med LN
  - 2, 3, 4, 5, 6, 7, 8, 9
- Stage IIIA
  - Non – Surgical
  - ? 5, 6

- Contra lateral Med/Hilar LN
- Stage IIIB
- Non - Surgical
“The prospect of cure depends on stage.”
Stefano Gasparini, MD Heidelberg, Sept. 2002

“If you don’t look at lymph nodes, everyone has stage I non-small cell lung cancer.”
Malcome DeCamp, Jr. MD Beth Israel Deaconess

MEDIASTINAL LYMPH NODE EVALUATION

- Non – Invasive
  - CT, PET, PET/CT
    - No confirmatory tissue
    - False Positive
- Invasive
    - Cervical / TEMLA
    - Chamberlain
  - VATS/Thoracotomy
- Minimally Invasive
  - Standard TBNA
  - EBUS-TBNA
  - EUS- FNA
  - Combined EBUS/EUS FNA
False Positive:
- Infectious:
  - Endemic mycoses
  - Tuberculosis
- Inflammatory:
  - Rheumatoid nodules
  - Sarcoidosis

False Negative
- Bronchioalveolar cell carcinoma
- Carcinoid tumors
- Mucinous adenocarcinoma

TABLE 1. TECHNIQUES FOR MEDIASTINAL LYMPH NODE STAGING

<table>
<thead>
<tr>
<th>Technique</th>
<th>Nodal Stations Accessible</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>FP (%)</th>
<th>FN (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical</td>
<td>1, 2, 3, 4, anterior 7</td>
<td>78</td>
<td>100</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Mediastinoscopy</td>
<td>90*</td>
<td>90*</td>
<td>100</td>
<td>7*</td>
<td>7*</td>
</tr>
<tr>
<td>Anterior</td>
<td>5, 6</td>
<td>75</td>
<td>100</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Mediastinotomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VATS</td>
<td>5, 6, 8, 9 ipsilateral</td>
<td>75</td>
<td>100</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>TBNA</td>
<td>2, 4, 7</td>
<td>78</td>
<td>100</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>TTNA</td>
<td>Mediastinal</td>
<td>89</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>EUS-FNA</td>
<td>2, 4, 5, 7, 8, 9</td>
<td>84</td>
<td>99.5</td>
<td>0.4</td>
<td>19</td>
</tr>
<tr>
<td>EBUS-TBNA</td>
<td>1, 2, 3, 4, 6, 10, 11</td>
<td>93</td>
<td>100</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

Definition of abbreviations: EBUS-NA: endobronchial ultrasound-guided transbronchial needle aspiration; EUS-FNA = endoscopic ultrasound-guided fine-needle aspiration; FN = false negative; FP = false positive; TBNA = transbronchial needle aspiration; TTNA = transthoracic needle aspiration; VATS = video-assisted thoracoscopic surgery.

* Videomediastinoscopy.
MEDIASTINOSCOPY

- “Gold Standard”
- Sensitivity – 78 - 90%
- Invasive procedure
- General Anesthesia
- Limited access to the posterior and inferior mediastinum
- 2% risk of major morbidity
- Cost

MINIMALLY INVASIVE TECHNIQUES

- Minimally Invasive
  - Standard TBNA
  - EBUS-TBNA
  - EUS- FNA
  - Combined EBUS/EUS FNA
Standard Transbronchial Needle Aspiration

• **TBNA needles**
  – 13 mm long
  – 22 gauge
  – 19 / 21 gauge

• Knowledge of node anatomical position

• Blind procedure

• Low Sensitivity/Specificity

Types of Endobronchial Ultrasound

• **Radial (Peripheral) Probe**
  – Passes through the working channel of a bronchoscope
  – Fitted with a water-inflatable balloon at the tip
  – Enables the evaluation of the airway wall and the adjacent mediastinal structures

• **Convex Probe**
  – Incorporated into the tip of a dedicated bronchoscope
  – Allows real-time imaging and sampling of tissue
Radial Probe EBUS

- Peripheral EBUS – 20 MHz
  - Visualization of airway wall and pulmonary parenchyma to the chest wall

Convex Probe EBUS

- The transducer is incorporated into the tip of the bronchoscope
- Dedicated for the real-time guidance of transbronchial needle aspiration (EBUS-TBNA)
- Frequency of 7.5 MHz - 12 MHz (lower resolution but deeper penetration)

Yasufuku, K. et al. Chest 2004;126:122-128
Convex Probe EBUS Bronchoscope

- Outer diameter of bronchoscope: 6.7 mm
- Outer diameter of tip: 6.9 mm
- Diameter of working channel: 2.0 mm
- Dedicated disposable needles are used (21 and 22 G)

US Aspects

- Contact method: direct contact of the probe with the bronchial wall or by inflating the balloon
- Scanning direction: linear curved array (scans parallel to the insertion direction)
- Generates a 50° image parallel to the long axis of the bronchoscope
- Has Doppler capability to differentiate vascular structures from tissue
Clinical Applications of EBUS-TBNA

• Lymph node staging in lung cancer patients (stations 1, 2, 3, 4, 7, 10, and 11)

• Diagnosis of unknown hilar and mediastinal lymphadenopathy

• Diagnosis of mediastinal tumors
EBUS-TBNA in the Staging of Lung Cancer - Experience to Date

• A large body of data exists (over 300 publications)

• Meta-analysis of EBUS-TBNA in the staging of lung cancer
  – 11 studies with 1299 patients met criteria and included in the study
  – Overall sensitivity 93%
  – Overall specificity 100%

Eur J Cancer. 2009 May;45(8):1389-96
• 4.4.4.3. In patients with high suspicion of N2,3 involvement, either by discrete mediastinal lymph node enlargement or PET uptake (and no distant metastases), a needle technique (endobronchial ultrasound [EBUS]-needle aspiration [NA], EUS-NA or combined EBUS/EUS-NA) is recommended over surgical staging as a best first test (Grade 1B).

The Role of EBUS in the Diagnosis of Other Mediastinal Diseases

• Is EBUS-TBNA a good diagnostic study to diagnose?
  – Lymphoma
  – Sarcoidosis
  – Other benign diseases (infectious)

  1) Yes
  2) No
The Role of EBUS in the Diagnosis of Other Mediastinal Diseases

Is EBUS-TBNA a good diagnostic study to diagnose?
- Lymphoma
- Sarcoidosis
- Other benign diseases (infectious)

1. Yes
2. No

The Role of EBUS-TBNA in the Diagnosis of Lymphoma

- Two studies exist:
  - Retrospective review of 25 patients referred for mediastinal lymphadenopathy
    - 13 had a prior history of lymphoma and 12 had mediastinal lymphadenopathy of unknown etiology
    - Sensitivity: 90.9%, specificity: 100%
  - Comments:
    - The presence of prior lymphoma diagnosis greatly facilitates diagnosis
    - Flow cytometry is essential for making the diagnosis of lymphoma
  - Another study prospectively evaluated 98 patients with suspected lymphoma
    - EBUS-TBNA sensitivity: 57%
    - Specificity: 100%
    - Surgical biopsy was avoided in a significant proportion of such patients (76%)

Kennedy M. Thorax 2008;63:360-365
Steinfort, DP. J Thorac Oncol. 2010;5(6):804-816
The Role of EBUS-TBNA in the Diagnosis of Sarcoidosis

- Study from MUSC
  - 50 consecutive patients referred for suspected sarcoidosis
  - EBUS-TBNA used to sample lymph nodes: average size 16 mm (range, 4-40 mm)
  - Diagnosis was established by seeing non-caseating granuloma
  - Sensitivity was 85%

- A randomized controlled trial of standard vs. EBUS guided TBNA in patients with suspected sarcoidosis
  - 24 patients randomized to EBUS-TBNA
  - 26 patients randomized to conventional TBNA
  - Diagnostic yield: 83.3% vs. 53.8% in favor of EBUS (p <0.05)

Garwood S. Chest 2007;132:1289-302
Tremblay, A. Chest 2009;136:340-346

RADIOLOGY – CASE 2
POST INTERVENTION
EBUS-TBNA Complications

• Overall very safe technique with no reported complications

• A few reports of infectious complications have emerged:
  – Infectious pericarditis/pericardial effusion after EBUS-TBNA of subcarinal mass
  – Tumor bed infection after EBUS-TBNA of right lung mass posterior to the bronchus intermedius
  – One case of mediastinal abscesses
  – Once case of ascending mediastinitis

• Possible explanations:
  • Deposition of oral contaminants into the lymph node or tumor mass caused the infection
  • Reporting bias of complications in a new technology

Moffatt-Bruce, SD. J Cardiothoracic Surg 2010;5:33

EBUS-TBNA Complications

• Incidence of bacteremia following EBUS-TBNA
  – 43 patients undergoing EBUS-TBNA had blood cultures within 60 seconds of the puncture
  – Incidence of bacteremia: 7%
    • Similar to bacteremia reported following routine flexible bronchoscopy
    • No clinical features suggestive of infections

EBUS and the SPN

• Peripheral EBUS
  – Advantages
    • Confirmation of position
  – Limitations
    • Actual biopsy performed with standard technique
    • Lack of directional biopsy

• Linear EBUS
  – Advantages
    • Direct visualized biopsy
  – Limitations
    • Diameter / Flexibility of endoscope
    • “Straight path”

CASE

• 76 y/o male with squamous cell lung cancer s/p XRT with increased lesion size.
EBUS and Stereotactic Radiotherapy

- Fiducial Placement
  - Lymph Nodes
  - Peripheral Pulmonary nodules / masses
CASE

- 77 y/o female with single enlarged hilar lymph node and history of squamous cell carcinoma.
EBUS BRONCHOSCOPY

• Advantages
  – Good Sensitivity and diagnostic yield
  – Access to majority of mediastinal / hilar LN
  – Airway evaluation
  – Other pulmonary procedures including FNA
  – Very safe

• Limitations
  – AP Window / Sub Diaphragmatic LN / Adrenal
  – Pulmonary status

CONCLUSIONS

• EBUS is an accurate, safe, and cost-effective primary procedure for mediastinal staging in lung cancer

• “A diagnosis should be obtained by whatever method is easiest in patients who are presumed to have SCLC or who have very clear evidence of advanced NSCLC”
  – Rivera et al CHEST 2007
NAVIGATIONAL BRONCHOSCOPY

BACKGROUND

• Lung Cancer is the #1 cause of cancer related death, and the #2 cause of mortality overall in the U.S.
• More than 150,000 pts/yr present with the diagnostic dilemma of a Solitary Pulmonary Nodule (SPN)
• Early detection and treatment of lung cancer can lead to increased 5 year survival
THE SOLITARY PULMONARY NODULE

- \( \leq 3 \text{ cm in short axis} \)
- Surrounded by aerated lung and not visible beyond the visual segmental bronchi
- Location:
  - Inner 2/3 of lung
  - Outer 1/3 of lung
  - Lobe / Segment

Adenocarcinoma

X-ray and Fluoro Invisible

12mm
NLST

• National Lung Cancer Screening Trial
  – Began enrollment in 2002
  – Low Dose CT vs. CXR
  – Annual examination for 3 years

• Inclusion Criteria
  – Current or former smokers aged 55-74

NLST

• Results
  – 20.3 % reduction in lung cancer mortality with CT
  – Actual Numbers
    • 53,500 participants from 33 centers
    • 354 deaths in CT group
    • 442 deaths in the CXR group

• Implications –
  – Large false-positive rate with screening CT
  – National Comprehensive Cancer Network (NCCN)
    • New guidelines for lung cancer screening
    • Low dose CT in select patient populations based on NLST data
  – USPSTF – Grade B Recommendation 2014
CURRENT DIAGNOSTIC MODALITIES

• Non-Invasive
  – Imaging via PET/CT Scan
  – Sputum Cytology

• Minimally – Invasive
  – Flexible Bronchoscopy
    • Fluoroscopy/ EMN/ EBUS
  – Transthoracic Needle Biopsy

• Invasive
  – VATS / Thoracotomy

POSITIVE EMISSION TOMOGRAPHY

False Positive:
• Infectious:
  – Endemic mycoses
  – Tuberculosis
• Inflammatory:
  – Rheumatoid nodules
  – Sarcoidosis

False Negative
• Bronchioloalveolar cell carcinoma
• Carcinoid tumors
• Mucinous adenocarcinoma
TRANSTHORACIC NEEDLE ASPIRATION (TTNA)

- Sensitivity rate = 80-95\%^{2}
- Specificity rate = 50-88\%^{2}
- False negative rate = 3-29\%^{2}
- Cannot be used in all cases due to co-morbidities, or lesion location

Complications:
- Pneumothorax (5-50\%)
  - Rate affected by size, distance, passes performed
  - 4% necessitates chest tube insertion
- Hemoptysis and hemorrhage (up to 10\%)


VATS / THORACOTOMY

- Highly invasive procedure
- Not suitable for patients with advanced disease or significant co-morbidities
- Associated with higher morbidity and mortality rates
BRONCHOSCOPY FOR SOLITARY PULMONARY NODULES

• Transbronchial biopsies with fluoroscopic guidance
  • > 2 cm Yield 63%
  • < 2 cm Yield <34%

Unchanged for previous 20 years

TRANSBRONCHIAL BIOPSY OF SPN

• Peripheral lesions are beyond bronchoscopic visualization
• Sampling techniques are guided using fluoroscopy
• Solid Lesions that are < 1 cm not visible with fluoroscopy
Lung Anatomy

FACTORS INCREASING YIELD OF FLEXIBLE BRONCHOSCOPY

• Size of the lesion
  – > 2cm increased yield to 63%
• Use of fluoroscopy
• Number of biopsies
  – 1 biopsy – 45%
  – 6 biopsies – 70%
• Visible airway to lesion (“Bronchus Sign”)
  – 60% vs 25%
• Endobronchial Ultrasound
• Electromagnetic Navigation
SuperDimension Electromagnetic Navigation

• Navigational System which utilizes GPS-like navigation and the patient’s natural airways to access peripheral pulmonary nodules
ELECTROMAGNETIC LOCATION BOARD

• Location board underneath mattress generates Electromagnetic Field

REAL TIME LOCATION
REAL TIME INFORMATION

- Miniaturized sensor delivers accurate information
- x, y, z, roll, pitch, and yaw
- 166 times/second

ELECTROMAGNETIC NAVIGATION BRONCHOSCOPY (ENB) PROCEDURE OVERVIEW

CT-Scan ➔ DICOM CD
Planning Software ➔ Planned Pathway File
Navigation ➔ Biopsy ➔ Treatment
Specific Parameters for Slice Thickness and Interval

ELECTROMAGNETIC NAVIGATION BRONCHOSCOPY (ENB)

Planning Phase:

- Visualize lung anatomy and airways in 3D
  - CT planar views, 3D map, and virtual bronchoscopy
- Mark the target and plan pathway
ELECTROMAGNETIC NAVIGATION BRONCHOSCOPY (ENB)

Procedure Phase:

- Automatic Registration (CT-to-body matching)
- Real-time virtual bronchoscopy navigation

Locatable Guide

Slide Courtesy of Michael J. Simoff, M.D.
EDGE CATHETER

PROCEDURE

Automatic CT-to-Body Registration
PROCEDURE

EBUS AND PERIPHERAL LESIONS
APPROACH TO DIAGNOSTIC MANEUVERS

• EMN used to navigate to lesion
• pEBUS through EWC to confirm lesion location
• Fluoroscopy to confirm position
• Transbronchial biopsies
  • 3 biopsies
  • Confirmation with pEBUS
  • 3 more biopsies
• pEBUS
• Brushings / TBNA
• 40 cc Normal Saline instilled for bronchial washing

EMN – Yield, Safety, and Efficacy

Becker et al. JOB 2005 30
• Registration accuracy (AFTIRE) 3mm
• Diagnostic Yield = 69%
• No serious complications related to use of device

Gildea et al. AJRCCM 2006 60
• Diagnostic Yield = 74% in peripheral lesion
• Diagnostic Yield = 100% in lymph nodes
• 57% of lesions were < 2cm in diameter

Makris et al. ERJ 2007 40
• Diagnostic Yield = 62.5%
• Diagnostic Yield 77.2% when divergence ≤ 4mm

Eberhardt et al. Chest 2007 89
• Positive biopsy obtained for 67% of lung lesions
• 88% of positive biopsies obtained at RML location

Eberhardt et al. AJRCCM 2007 120
• Positive biopsy obtained in 65% of EBUS group
• Positive biopsy obtained in 59% of ENB group
• Positive biopsy obtained in 88% of EBUS + ENB group
• Yield in independent of lesion size or lobar distribution

Wilson, et al. JOB 2007 248
• ENB successfully reached 95% of peripheral lesion and 94.3% of lymph nodes
• On day of procedure, 65% of patients received a definitive malignant or plausible non-malignant diagnosis; with follow-up another 5% confirmed as non-malignant

Bertoletti et al. Respiration 2009 54
• Diagnostic success rate of 71.4% with median tumor size of 28mm
• 4% pneumothorax rate; 1 requiring chest tube

Edell et al. New Current Procedural Terminology Codes Effective 2010 -
• Summary of 600 patients with ENB experience
• Conclusion: ENB has potential to improve diagnostic yield of transbronchial biopsy and may be useful in early diagnosis of lung cancer
BRONCHOSCOPY FOR SOLITARY PULMONARY NODULES

• Transbronchial biopsies with fluoroscopic guidance
  – > 2 cm
    • Yield 63%
  – < 2 cm
    • Yield < 34%

Now 77%-88% with electromagnetic navigation + pEBUS

ACCP PRACTICE GUIDELINES
DIAGNOSIS AND MANAGEMENT OF LUNG CANCER 3rd ED 2013

• 3.4.2.1. In patients with peripheral lung lesions difficult to reach with conventional bronchoscopy, electromagnetic navigation guidance is recommended if the equipment and the expertise are available (Grade 1C).
Tissue Sampling Evidence

**Original Investigation**

65 ENB cases resulted in a diagnosis of lung cancer. Tissues obtained were adequate for histologic subtyping in all 65 cases.

**Cancer With Tissue Obtained by Electromagnetic Navigation Bronchoscopy**

Duc Ha, MD,* Humberto Choi, MD,† Francisco A. Ahmida, MD, MS,‡ Andrea Arcossi, MD,‡ Jennifer Brainard, MD,‡ Joseph Cicenia, MD,† Carol Farver, MD,‡Thomas Gildea, MD, MS,‡ Michael S. Machoah, MD,‡ and Peter Mazzone, MD, MPH†

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**Background:** Electromagnetic navigation bronchoscopy (ENB) is a catheter-based adjunct to standard bronchoscopic techniques for the sampling of lung lesions. We sought to evaluate the adequacy of ENB-obtained samples for histologic subtyping of lung cancer, epidermal growth factor receptor (EGFR) mutations, and ALK translocation.

**Conclusions:** ENB is effective at obtaining tissue samples adequate for histologic subtyping, EGFR mutation, and EML4-ALK translocation analysis.

**Key Words:** electromagnetic navigation bronchoscopy, lung cancer, histology, immunohistochemistry, epidermal growth factor receptor (EGFR) mutation, echinoderm

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**OTHER APPLICATIONS**

- Fiducial Marker Placement
RADIOSURGICAL MARKER APPLICATION

• Primary Treatment Modality with Curative Intent
  – Inoperable patients (COPD, ILD)
  – Patients who refuse surgery

• (Neo) Adjuvant Treatment
  – Pre-operative treatment for subsequent surgical curative intent (IIIA disease)

• Palliative Therapy

STEREOTACTIC RADIOTHERAPY
STEREOTACTIC RADIOTHERAPY

• Current Challenges
  – Lung tumor movement occurs with respiratory cycle
    • Unpredictable baseline shifts and variable amplitude of respiratory rates
    • Change in tumor morphology or position relative to other structures
  – Accurate alignment during stereotactic planning and delivery is required
    • maximize radiation to target
    • minimize “collateral damage”
• EMN radiosurgical marker placement provides enhanced localization of tumor during respiratory variation to guide radiotherapy with minimal risk
  – Pneumothorax
  – Migration

1. Eberhardt, et al., 2007
2. Wilson, et al., JCB 2007

STEREOTACTIC RADIOTHERAPY

Planning Phase
• Target selected lesions with planning software

Navigation
• EMN navigation to lesion

Marker Placement – Several Markers and Methods
• Angiocatheter with backloading (labeled)
• Wang/Conmed 19ga/21ga TBNA
• Endobronchial brush

Stereotactic radiotherapy treatment
STEREOTACTIC RADIOTHERAPY

McLemore et al. WCB 2006
20
• Accurate and safe approach
• No complications
• Markers were very stable

Anantham et al. Chest 2007
9
• Lesion size: 35.8 ± 16.7mm
• Markers successfully placed in 89% (8/9 patients)
• 90% of markers still in place after 7-10 days
• No bronchoscopic complications observed

McGuire et al. JOB 2007
• Angulated catheter method provides most accurate and safe method
• Angulated catheter allows the placement of markers in multiple planes without withdrawing the catheter

8
• Average lesion size was 2.6mm
• No pneumothorax
• Implanted markers were stable within tumor throughout treatment duration regardless of implantation method

Quinn, et al. ACRO 2009 and CyberKnife 2009
44
• 23 transcutaneous placement; 10 developed pneumothorax (43%)
• 21 transbronchial placement; 3 developed pneumothorax (14%)
• 3 patients had marker migration with transbronchial; no migration with transcutaneous

43
• ENB was used in 12 patients with peripheral lesions
• Average of 3.7 markers per patient were deployed
• 86.7% of markers identified radiologically at SRS planning CT, 2 weeks after deployment
• 1 pneumothorax (pigtail catheter placement)
• All patients were able to undergo SRS without additional marker placement or other procedures

LIMITATIONS

• Not every patient is a good candidate
  • “The Bronchus Sign”
“The Bronchus Sign”

- Visible airway on CT imaging leading to SPN

- Prior reports demonstrate increased diagnostic yield (60% vs. 25%)

- Seijo et al - Evaluation of bronchus sign with EMN
  - Results: 67% total diagnostic yield (34/51)
    - With bronchus sign – 79% (30/38)
    - Without bronchus sign – 13% (4/13)

OTHER PERCEIVED LIMITATIONS

- Reimbursement
  - CPT code now available with increased value in 2013

  - Down Stream Revenue Generation
    - Radiology
    - CT Surgery
    - Oncology
    - Radiation Oncology
    - Pathology
    - Recovery Area / PACU
CASE PRESENTATIONS

• 63 y/o female with severe COPD with enlarging PET negative pulmonary nodule

• Best method of diagnosis?
  1) Surveillance imaging
  2) CT guided biopsy
  3) Bronchoscopy with navigation and trans bronchial biopsy
  4) Open lung biopsy
Best method of diagnosis?

1. Surveillance imaging
2. CT guided biopsy
3. Bronchoscopy with navigation and trans bronchial biopsy
4. Open lung biopsy
Diagnosis

CASE PRESENTATION

• 73 y/o male with a newly noted left lower lobe lung nodule
CASE PRESENTATION

• 67 y/o male recently heard about lung cancer screening. 50 pack year history of smoking
CASE PRESENTATION

- 64 y/o female with a 40 pack year history of smoking. Recently released from jail
What Next?

• All cultures negative
• Stains negative
• Serologies negative

• Any further diagnostic testing necessary?
  1) None needed
  2) CT guided biopsy
  3) Open lung biopsy
AFB IHC Positive – Dx: Tuberculosis
Who should Navigational Bronchoscopy and EBUS Bronchoscopy be performed by?

1) Only by trained Interventional Pulmonologists in tertiary referral centers

2) Any Pulmonary physician with the resources and expertise to perform the procedure safely and accurately
Thank You!

Samir Makani, MD
Interventional Pulmonology
University of California, San Diego

SSMakani@ucsd.edu

O:619-543-2793