Bronchoscopy’s Re-emerging Role in the Evaluation of Patients with Lung Cancer

Robert W. Viggiano, MD

Objectives

- Historical overview
- Role in endobronchial disease
- Role in parenchymal disease including BAL and Biopsy
- Role of conventional Bronchial needle aspiration
- Role of endobronchial ultrasound
- Review of newer technologies

HISTORY

- 1897. Gustav Killian of Freiburg, Germany, used a rigid endoscope to examine the airways.
- 1898. First bronchoscopy done in US.
- 1899. Chevalier Jackson refined the rigid bronchoscope.
- 1970. Shigeto Ikeda developed the flexible fiberoptic bronchoscope and introduced it into clinical use.
The traditional fiberoptic bronchoscopy is gradually giving way to videobronchoscopy.

- Videobronchoscopy is equipped with a charge-coupled device at its distal tip.
- Images are digitally captured and transmitted to a video processor for display on a monitor.
- Advantages are higher quality images that can be simultaneously visualized by many for teaching.

Bronchoscopy allows for inspection of all the major airways to 4th or 5th generation.

- Provides access for washings, brushings and biopsy of endobronchial lesions.
- Provides access for washings, brushings and biopsy of parenchymal abnormalities of nodules or in localized-diffuse disease.
- Provides access for bronchialveolar lavage.
- Provides access for tracheal/tracheal needle aspiration.
Slide 7

Bronchial Brush

Endobronchial or peripheral lesions are easily brushed for cytology.

Various sizes 2, 5 and 7 mm.

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Bronchial Biopsy Forceps

Forceps have hinged cups and a cutting edge.

Most forceps have a window on each cup to reduce crushing artifact.

Can use any forceps to biopsy a central or peripheral lesion.

Slide 9

Brushings and Biopsy

- Endobronchial lesions are easily washed, brushed and biopsied.
- Bleeding is the most common complication.
- Bronchial biopsy of visible endobronchial bronchogenic carcinomas is positive in 73-96%.
- Studies have shown that 3-5 biopsies are needed to improve the sensitivity.
- Brushing provides a similar yield to biopsies.
Slide 10

Bronchialveolar Lavage (BAL)
• BAL is common procedure for evaluating possible
• Provides important information about infectious inflammatory and immunologic processes
• Minimally invasive method and safe
• Lavage is performed on where the disease is most prominent radiographically

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Bronchialveolar Lavage (BAL)
• BAL is performed following general inspection before biopsy or brushing
• Minimizes the likelihood that iatrogenic bleeding will alter the concentration of cellular and protein components
• Scope advanced into a subsegmental bronchus until the lumen is occluded or wedged
• 20ml of saline are instilled at a time up to 100ml

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Bronchialveolar Lavage
• Recovered fluid is pooled in a single trap
• Most commonly used in the evaluation of the immunocompromised host with indeterminate infiltrate
• Can be helpful in diagnosing eosinophilic pneumonia, hemorrhage and to a lesser extent hypersensitivity pneumonia and sarcoidosis
Transbronchial Lung Biopsy

- Transbronchoscopic or transbronchial lung biopsy (TBLB), refers to the bronchoscopic technique of obtaining pulmonary parenchymal tissue for histological analysis.
- Usually performed with fluoroscopic guidance.
- 1st described in 1965 by Howard Anderson and Robert Fontana at Mayo Clinic; reported on TBLBx obtained via rigid bronchoscopy in 13 pts with diffuse lung disease.

1972 Anderson reported adequate lung tissue was obtained in 84% of 450 patients with diffuse lung diseases.
- 1974 Levin reported positive biopsies in 82% of patients with TBLBx using the flexible fiberoptic bronchoscopy (FFB).
- Prior to this, tissue sampling was limited to transthoracic needle aspiration and surgery.
- TBLBx is a well-established diagnostic technique.
- TBLBx is safe and a useful clinical tool.
- 1991 ACCP survey showed nearly 70% of 1,800 performed TBLBx routinely in their practice for diffuse lung.

Technique

- Bronchoscope is wedged in the segmental bronchus.
- Biopsy forceps is passed through the working channel of the bronchoscope.
- Fluoroscopy unit is activated to allow visualization of the forceps as it enters the distal segments of the lung.
- Advance forceps to the periphery of the diseased region until resistance is encountered or near pleura.
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**Transbronchial Lung Biopsy**
- Forceps is withdrawn approximately 2-3 cm and then opened and advanced slightly to obtain the sample of the lung
- When resistance is encountered the forceps are closed
- The biopsy forceps is firmly retracted to obtain the sample
- Scope stays wedged in the bronchial segment
- Biopsy repeated several times

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**Transbronchial Lung Biopsy**
- The sample is placed in formalin and sent for histopathologic evaluation
- The ideal transbronchial biopsy specimen consists of 4-6 samples, with at least 1 sample containing full-thickness bronchial mucosa and some alveolar parenchyma

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**Transbronchial Lung Biopsy**
**Utilization of TBLBx in Diffuse Diseases**
- Granulomatous Disorders
- Malignant tumors lymphangitic spread
- Eosinophilic pneumonia
- Alveolar proteinosis
- Infection
- Not routinely used in evaluation of patient with suspected IPF
Transbronchial Lung Biopsy
Nodules and Masses

- TBLBx is commonly used to determine the etiology of parenchymal nodules and masses
- TBLBx diagnostic accuracy increases
  - A) increases when the nodule is larger than 2 cm or
  - B) there is a bronchus leading to the nodule on the CT Chest (positive bronchus sign)
- The yield of TBLBx is 40-70% for nodules > 2cm and < 20% for lesions < 2cm

Positive bronchus sign

Percutaneous Needle Aspiration

- Percutaneous needle aspiration with CT guidance is another way of establishing a diagnosis in a SPN or lung mass
- In a meta-analysis of 13,499 patients percutaneous needle aspiration detected malignancy with a sensitivity and specificity of 90 and 97 percent
- False positive rate was 1%
- False negative negative was 20-30%
1949 Argentinean surgeon named Eduardo Schieppati published his findings on subcarinal puncture; known as the “Father of TBNA.”

Early 1970s Wang reinvented and introduced TBNA using the rigid bronchoscope and several years later through the flexible scope.

TBNA is easy to learn and perform, but only 20-30% of pulmonologists use TBNA.

Most common application of TBNA is the diagnosis and staging of lung cancer.

TBNA can be used to sample:
- Endobronchial lesions
- Submucosal or peribronchial lesions
- Peripheral lesions
- Lymph nodes

All needle systems for transbronchial aspiration consist of:
- A retractable sharp beveled flexible needle
- A flexible catheter
- A proximal control device to manipulate the needle, the stylet, or both, and a side port through which suction can be applied
- Aspiration needle is available in 19-gauge, 20-gauge, and 21-gauge.
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**TRANSBRONCHIAL NEEDLE ASPIRATION**
- Conventional TBNA relies on "blind" needle puncture
- Bronchoscopist reviews the CT Chest or PET scan images and passes the needle in the determined location

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**BLIND TBNA**

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**TRANSBRONCHIAL NEEDLE ASPIRATION**
- Diagnostic yield of TBNA in the diagnosis and staging of lung cancer has been reported to range from 20% to 80%
- A meta-analysis of 13 studies found that the sensitivity and specificity of TBNA for the diagnosis of non-small cell lung cancer was 39% and 99%, respectively
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TRANSBRONCHIAL NEEDLE ASPIRATION

• Complications are rare and include pneumothorax and hemomediastinum.
• Serious bleeding is seldom encountered
• Only 20-30% of pulmonologists reported using TBNA in their practice

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TRANSBRONCHIAL NEEDLE ASPIRATION

Factors affecting Diagnostic yield of TBNA include:
• Likelihood of malignancy
• Location and size of the lesion or lymph node
• Visibility and carinal involvement of the tumor
• Technical issues can influence diagnostic yield, including operator experience, the type of needle, the number of attempts, the number of aspirates, and the presence of a cytologist

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Q1: You are seeing a 56 YO male, former smoker. A chest x-ray done for cough showed a RUL mass. CT shows a 3.5 cm mass and enlarged (1.5 cm) station 7 and 4 R nodes.
Q1. Which of the following would you recommend as a next step?

A) Mediastinoscopy and resection if nodes are negative
B) PET Scan; node neg operate
C) Bronchoscopy with blind TBNA
D) Endobronchial ultrasound TBNA
E) Referral to oncology

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**Lung Cancer Staging**

- Non-small cell lung carcinoma (NSCLC) accounts for 80% of all bronchogenic carcinomas
- After diagnosis, staging becomes the most important task
- Evaluation for possible spread to thoracic structures, including mediastinal lymph nodes, and to extrathoracic organs

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**Lung Cancer Staging**

- CT Chest provides information about the lymph nodes and possible spread to other thoracic structures
- Lymph nodes are defined as pathologic based solely on short axis size greater than 1 cm
- Enlarged nodes are worrisome and need to be further evaluated
- Normal mediastinum with no lymphadenopathy allows for surgical resection; mediastinal lymph nodes usually sampled at thoracotomy

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Lung Cancer Staging

CT Chest

- A meta-analysis of CT accuracy for assessment of mediastinal lymph node involvement in bronchogenic carcinoma found an overall sensitivity and specificity of 79% and 78%
- Up to 30% of patients with enlarged nodes on CT do not have evidence of neoplastic disease at surgery
- 3% to 16% of patients with mediastinal lymph nodes less than 1 cm on CT have tumor involvement at mediastinoscopy.

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Lung Cancer Staging

Positron Emission Tomography (PET)

- Sensitivity and specificity of PET for diagnosing mediastinal disease were 83% and 94%, respectively, while CT had a sensitivity of 63% and specificity of 73%
- 20% improvement in accuracy of PET over CT imaging for mediastinal staging of NSCLC
- PET allows for identification of distant metastasis

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Lung Cancer Staging

Mediastinoscopy

- Surgical staging of the mediastinum is often performed prior to primary resection
- Mediastinoscopy, anterior mediastinotomy, and ultimately thoracotomy have been the standard approach
- Mediastinoscopy is the historic gold standard for staging the mediastinum
- Overall, mediastinoscopy has a reported sensitivity of 87% and specificity of 100%.
Lung Cancer Staging
Mediastinoscopy

- Mediastinoscopy is most often used to sample lymph nodes in the paratracheal and anterior subcarinal area.
- Subcarinal area is more difficult to sample
- Anterior mediastinotomy is needed to sample lymphatics in the subaortic and lateral aortic region
- Mediastinoscopy requires general anesthesia
- Has a morbidity of 1% and a mortality of 0.2%

ENDOSCOPIC ULTRASOUND

- 1980s endoscopic ultrasound (EUS) developed
- EUS has become an integral part of the evaluation for GI malignancies in particular esophageal cancers using a radial probe
- EUS provides access to the mediastinum
- Useful in the diagnosis and staging of lung cancer through the performance of needle aspiration of mediastinal masses and lymph nodes

ENDOSCOPIC ULTRASOUND

- EUS doesn’t provide complete visualization of mediastinal structures
- Limitations due to airway interference
- Lymph node stations 2R, 3, and 4R were deemed poorly accessible by this approach
- Lead to evolution of ultrasound technology for an endobronchial approach
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**ENDOBRONCHIAL ULTRASOUND**

- Endobronchial ultrasound (EBUS) is a technique that uses ultrasound along with bronchoscope to visualize airway wall and structures adjacent to it.

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**ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION**

Provides access to many lymph node stations:
- Highest mediastinal (station 1)
- Upper paratracheal (station 2R, 2L)
- Lower paratracheal (station 4R, 4L)
- Subcarinal (station 7)
- Hilar (station 10),
- Interlobar (station 11) lymph nodes

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**ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION**

Not accessible stations:
- Para-aortic (6),
- Aorto-pulmonary window or subaortic (5)
- Paraesophageal (8)
- Pulmonary ligament (9) lymph node stations
• EBUS-TBNA is indicated for the assessment of mediastinal and hilar lymph nodes, and diagnosis of lung and mediastinal tumors
• Safe procedure
• Few serious complications including pneumothorax, pneumomediastinum, and hemomediastinum

ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION

• EBUS utilizes the linear probe also known as convex probe EBUS
• Incorporates a convex transducer with a frequency of 7.5 MHz at the tip of a flexible bronchoscope
• Probe scans parallel to the insertion direction of the bronchoscope, generating a 50-degree image

The linear EBUS, also known as convex probe EBUS

incorporates a convex transducer with a frequency of 7.5 MHz at the tip of a flexible bronchoscope
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Balloon on tip inflates with saline providing better images

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Ultrasound Bronchoscopy
Linear Transducer

Ultrasound Bronchoscopy
Linear Transducer

Fiberoptic Bundle    Transducer    Working Channel

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Slide 50

EBUS

- EBUS is usually performed under procedural sedation and local anesthesia or under general anesthesia.
- The use of a laryngeal mask airway allows access to upper paratracheal nodes.
- The size of endotracheal tube should be at least No. 8 or larger.
- Usually begin procedure with the flexible scope to inspect the airways.

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EBUS

- Ultrasound images are obtained by placing the probe in direct contact to the trachea or bronchial wall.
- Using the water-filled balloon can improve the imaging quality.
- Ultrasound images can be frozen, allowing for measurement of the lesion or lymph node in two dimensions.
Frozen Ultrasound image allows for measurement of appropriate needle depth.

EBUS
- The target lymph node is identified using linear EBUS probe.
- Under real-time ultrasonic guidance, the needle is inserted into the lesion and suction is applied by a syringe.
- The needle is moved back and forth inside the lesion for 20 to 30 seconds.
- Needle is retrieved, locked, and the internal sheath and the catheter are removed.

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• The number of needle aspirations per site can impact the yield and range from 3-7 depending on the study.
• The inner diameter of the needle allows the sampling of histologic cores in some cases, but most samples are evaluated by cytologic examination.
• If the TBNA is being done for staging of NSCLC, the sampling should be started from N3 followed by N2 and N1 lymph nodes to avoid contamination and upstaging.

• The aspirated material is smeared onto glass slides, air-dried, and fixed in 95% alcohol.
• Dried smears can be evaluated by an on-site cytopathologist to confirm an adequate lymph node sampling, and in a substantial number of cases a preliminary diagnosis can be made.
• Histologic specimens obtained are fixed in formalin before being sent to the pathology department.
EBUS

• Nondiagnostic findings without malignant cells nor lymphocytes occur in as many as 20% of individual aspirates and 10% of cases
• Most studies report a positive predictive value of 100% for EBUS-TBNA, and therefore confirmatory mediastinoscopy is not needed
• Surgical staging is indicated for negative and nondiagnostic needle aspiration cases
• EBUS-TBNA is best regarded as complementary to, but not as a substitute for surgical staging of the mediastinum

EBUS

• Rapid On-Site cytological Evaluation (ROSE) of the aspirated specimens has been shown to be effective in optimizing the yield and efficiency of EBUS-TBNA
• In a large meta-analysis, ROSE was associated with increased sensitivity of EBUS-TBNA from 80% to 98% without increasing procedure length
• Staffing, time, and cost constraints limit availability

EBUS

Molecular Markers

• Cytological specimens can be obtained for molecular testing for EGFR, K-ras and ALK
• Exact yield for this testing is presently unknown at present
• Bronchoscopist working with the cytologist, must take responsibility for ensuring the adequacy and proper processing of the specimen
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- Electromagnetic Navigational Bronchoscopy (ENB)
- Radial Probe

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ELECTROMAGNETIC NAVIGATIONAL BRONCHOSCOPY (ENB)

- 2008 Cleared by the US FDA to “display images of the tracheobronchial tree to aid the physician in guiding endoscopic tools or catheters in the pulmonary tract and to enable marker placement within soft lung tissue. It does not make a diagnosis and is not an endoscopic tool.”

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ELECTROMAGNETIC NAVIGATIONAL BRONCHOSCOPY (ENB)

ENB procedure uses three technologies

- Planning software that converts DICOM images from a CT scan into three-dimensional reconstruction and virtual bronchoscopy of the airways
- Steerable sensor probe designed with the ability to navigate turns in the endobronchial tree
- Electromagnetic navigation board, a field generator connected to a computer containing the planning data
ENB Results
49 patients: Mean diameter 22.8 mm
  • Overall diagnostic yield 74%
  • Procedure time mean 51 min (33-86)
  • 2 Pneumothorax

40 patients: mean diameter 23.5 mm
  • Overall yield 62.5%
  • 3 pneumothorax

RADIAL PROBE ULTRASOUND
SPNs

• Rotating transducer at tip of probe
• Inserted through standard bronchoscopic channel
• Tissue penetration 4-5 cm
• Used primarily to visualize peripheral pulmonary nodules
• Remove the probe and pass the brush or forceps through the sheath
• Overall yield between 45-60%
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• Role of conventional Bronchial needle aspiration
• Role of endobronchial ultrasound
• Review of newer technologies
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BRONCHOSCOPY

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BRONCHOSCOPY

• Allows for inspection of all the major airways to 4\textsuperscript{th} or 5\textsuperscript{th} generation
• Provides access for washings, brushings and biopsy of endobronchial lesions
• Provides access for washings, brushings and biopsy of parenchymal abnormalities of nodules or in localized/diffuse disease
• Provides access for bronchioalveolar lavage
• Provides access for tracheal/bronchial needle aspiration
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Various sizes 2, 5 and 7 mm
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Transbronchial Lung Biopsy
Technique

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- Forceps is withdrawn approximately 2-3 cm and then opened and advanced slightly to obtain the sample of the lung
- When resistance is encountered the forceps are closed
- The biopsy forceps is firmly retracted to obtain the sample
- Scope stays wedged in the bronchial segment
- Biopsy repeated several times
Transbronchial Lung Biopsy

- The sample is placed in formalin and sent for histopathologic evaluation.
- The ideal transbronchial biopsy specimen consists of 4-6 samples, with at least 1 sample containing full-thickness bronchial mucosa and some alveolar parenchyma.
Transbronchial Lung Biopsy

Utilization of TBLBx in Diffuse Diseases

• Granulomatous Disorders
• Malignant tumors lymphangitic spread
• Eosinophilic pneumonia
• Alveolar proteinosis
• Infection

• Not routinely used in evaluation of patient with suspected IPF
Transbronchial Lung Biopsy
Nodules and Masses

• TBLBx is commonly used to determine the etiology of parenchymal nodules and masses

TBLBx diagnostic accuracy increases

• A) increases when the nodule is larger than 2 cm or

• B) there is a bronchus leading to the nodule on the CT Chest (positive bronchus sign)

• The yield of TBLBx is 40-70% for nodules > 2 cm and < 20% for lesions < 2 cm
Positive bronchus sign
Percutaneous Needle Aspiration

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- False negative rate was 20-30%.
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TRANSBRONCHIAL NEEDLE ASPIRATION

- Most common application of TBNA is the diagnosis and staging of lung cancer.

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TRANSBRONCHIAL NEEDLE ASPIRATION

• Conventional TBNA relies on “blind” needle puncture

• Bronchoscopist reviews the CT Chest or PET scan images and passes the needle in the determined location
BLIND TBNA
• Diagnostic yield of TBNA in the diagnosis and staging of lung cancer has been reported to range from 20% to 80%

• A meta-analysis of 13 studies found that the sensitivity and specificity of TBNA for the diagnosis of non-small cell lung cancer was 39% and 99 %, respectively
Complications are rare and include pneumothorax and hemomediastinum.

Serious bleeding is seldom encountered.

Only 20-30% of pulmonologist reported using TBNA in their practice.
Factors affecting Diagnostic yield of TBNA include:

- Likelihood of malignancy
- Location and size of the lesion or lymph node
- Visibility and carinal involvement of the tumor
- Technical issues can influence diagnostic yield, including operator experience, the type of needle, the number of attempts, the number of aspirates, and the presence of a cytologist
Q1). You are seeing a 56 YO male, former smoker. A chest x-ray done for cough showed a RUL mass: CT shows a 3.5 cm mass and enlarged (1.5 cm) station 7 and 4 R nodes.
Q1). Which of the following would you recommend as a next step?

A) Mediastinoscopy and resection if nodes are negative
B) PET Scan; node neg operate
C) Bronchoscopy with blind TBNA
D) Endobronchial ultrasound TBNA
E) Referral to oncology
Lung Cancer Staging

- Non–small cell lung carcinoma (NSCLC) accounts for 80% of all bronchogenic carcinomas

- After diagnosis, staging becomes the most important task

- Evaluation for possible spread to thoracic structures, including mediastinal lymph nodes, and to extrathoracic organs
Lung Cancer Staging

- CT Chest provides information about the lymph nodes and possible spread to other thoracic structures.
- Lymph nodes are defined as pathologic based solely on short axis size greater than 1 cm.
- Enlarged nodes are worrisome and need to be further evaluated.
- Normal mediastinum with no lymphadenopathy allows for surgical resection; mediastinal lymph nodes usually sampled at thoracotomy.
A meta-analysis of CT accuracy for assessment of mediastinal lymph node involvement in bronchogenic carcinoma found an overall sensitivity and specificity of 79% and 78%.

Up to 30% of patients with enlarged nodes on CT do not have evidence of neoplastic disease at surgery.

3% to 16% of patients with mediastinal lymph nodes less than 1 cm on CT have tumor involvement at mediastinoscopy.
Lung Cancer Staging
Positron Emission Tomography (PET)

- Sensitivity and specificity of PET for diagnosing mediastinal disease were 83% and 94%, respectively, while CT had a sensitivity of 63% and specificity of 73%.

- 20% improvement in accuracy of PET over CT imaging for mediastinal staging of NSCLC.

- PET allows for identification of distant metastasis.
Lung Cancer Staging
Mediastinoscopy

• Surgical staging of the mediastinum is often performed prior to primary resection

• Mediastinoscopy, anterior mediastinotomy, and ultimately thoracotomy have been the standard approach

• Mediastinoscopy is the historic gold standard for staging the mediastinum

• Overall, mediastinoscopy has a reported sensitivity of 87% and specificity of 100%.
Lung Cancer Staging
Mediastinoscopy

- Mediastinoscopy is most often used to sample lymph nodes in the paratracheal and anterior subcarinal area.
- Subcarinal area is more difficult to sample.
- Anterior mediastinotomy is needed to sample lymphatics in the subaortic and lateral aortic region.
- Mediastinoscopy requires general anesthesia.
- Has a morbidity of 1% and a mortality of 0.2%.
- Expensive.
ENDOSCOPIC ULTRASOUND

• 1980s endoscopic ultrasound (EUS) developed
• EUS has become an integral part of the evaluation for GI malignancies in particular esophageal cancers using a radial probe
• EUS provides access to the mediastinum
• Useful in the diagnosis and staging of lung cancer through the performance of needle aspiration of mediastinal masses and lymph nodes
ENDOSCOPIC ULTRASOUND

- EUS doesn’t provide complete visualization of mediastinal structures
- Limitations due to airway interference
- Lymph node stations 2R, 3, and 4R were deemed poorly accessible by this approach
- Lead to evolution of ultrasound technology for an endobronchial approach
Endobronchial ultrasound (EBUS) is a technique that uses ultrasound along with bronchoscope to visualize airway wall and structures adjacent to it.
ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION

Provides access to many lymph node stations

- Highest mediastinal (station 1)
- Upper paratracheal (station 2R, 2L)
- Lower paratracheal (station 4R, 4L)
- Subcarinal (station 7)
- Hilar (station 10),
- Interlobar (station 11) lymph nodes
ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION

Not accessible stations

- Para-aortic (6),
- Aorto-pulmonary window or subaortic (5)
- Paraesophageal (8)
- Pulmonary ligament (9) lymph node stations
ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION

• EBUS-TBNA is indicated for the assessment of mediastinal and hilar lymph nodes, and diagnosis of lung and mediastinal tumors

• Safe procedure

• Few serious complications including pneumothorax, pneumomediastinum, and hemomediastinum
**ENDOBRONCHIAL ULTRASOUND NEEDLE ASPIRATION**

- EBUS utilizes the linear probe also known as convex probe EBUS.
- Incorporates a convex transducer with a frequency of 7.5 MHz at the tip of a flexible bronchoscope.
- Probe scans parallel to the insertion direction of the bronchoscope, generating a 50-degree image.
The linear EBUS, also known as convex probe EBUS incorporates a convex transducer with a frequency of 7.5 MHz at the tip of a flexible bronchoscope.
Balloon on tip inflates with saline providing better images
Ultrasound Bronchoscopy
Linear Transducer

Fiberoptic Bundle  Transducer  Working Channel
Visual angle 35° forward oblique
Visual field of view 80°

US angle of view 50°

Trachea

Linear probe EBUS

Needle angle of exit 20°
EBUS

- EBUS is usually performed under procedural sedation and local anesthesia or under general anesthesia
- The use of a laryngeal mask airway allows access to upper paratracheal nodes
- The size of endotracheal tube should be at least No. 8 or larger
- Usually begin procedure with the flexible scope to inspect the airways
• Ultrasound images are obtained by placing the probe in direct contact to the trachea or bronchial wall

• Using the water-filled balloon can improve the image quality

• Ultrasound images can be frozen, allowing for measurement of the lesion or lymph node in two dimensions
Frozen Ultrasound image allows for measurement of appropriate needle depth.
EBUS

- The target lymph node is identified using linear EBUS probe
- Under real-time ultrasonic guidance, the needle is inserted into the lesion and suction is applied by a syringe
- The needle is moved back and forth inside the lesion for 20 to 30 seconds
- Needle is retrieved, locked, and the internal sheath and the catheter are removed
EBUS

• The number of needle aspirations per site can impact the yield and range from 3-7 depending on the study

• The inner diameter of the needle allows the sampling of histologic cores in some cases, but most samples are evaluated by cytologic examination

• If the TBNA is being done for staging of NSCLC, the sampling should be started from N3 followed by N2 and N1 lymph nodes to avoid contamination and upstaging
EBUS

- The aspirated material is smeared onto glass slides, air-dried, and fixed in 95% alcohol.
- Dried smears can be evaluated by an on-site cytopathologist to confirm an adequate lymph node sampling, and in a substantial number of cases a preliminary diagnosis can be made.
- Histologic specimens obtained are fixed in formalin before being sent to the pathology department.
EBUS

- Nondiagnostic findings without malignant cells nor lymphocytes occur in as many as 20% of individual aspirates and 10% of cases.
- Most studies report a positive predictive value of 100% for EBUS-TBNA, and therefore confirmatory mediastinoscopy is not needed.
- Surgical staging is indicated for negative and nondiagnostic needle aspiration cases.
- EBUS-TBNA is best regarded as complementary to, but not as a substitute for surgical staging of the mediastinum.
EBUS

• Rapid On-Site cytological Evaluation (ROSE) of the aspirated specimens has been shown to be effective in optimizing the yield and efficiency of EBUS-TBNA

• In a large meta-analysis, ROSE was associated with increased sensitivity of EBUS-TBNA from 80% to 88% without increasing procedure length

• Staffing, time, and cost constraints limit availability
EBUS
Molecular Markers

• Cytological specimens can be obtained for molecular testing for EGFR, K-ras and ALK

• Exact yield for this testing is presently unknown at present

• Bronchoscopist working with the cytologist, must take responsibility for ensuring the adequacy and proper processing of the specimen
• Electromagnetic Navigational Bronchoscopy (ENB)
• Radial Probe
ELECTROMAGNETIC NAVIGATIONAL BRONCHOSCOPY (ENB)

- 2008 Cleared by the US FDA to “display images of the tracheobronchial tree to aid the physician in guiding endoscopic tools or catheters in the pulmonary tract and to enable marker placement within soft lung tissue. It does not make a diagnosis and is not an endoscopic tool.”
ELECTROMAGNETIC NAVIGATIONAL BRONCHOSCOPY (ENB)

ENB procedure uses three technologies

• Planning software that converts DICOM images from a CT scan into three-dimensional reconstruction and virtual bronchoscopy of the airways;

• Steerable sensor probe designed with the ability to navigate turns in the endobronchial tree

• Electromagnetic navigation board, a field generator connected to a computer containing the planning data
ENB Results

49 patients: Mean diameter 22.8 mm
- Overall diagnostic yield 74%
- Procedure time mean 51 min (33-86)
- 2 Pneumothorax

40 patients: mean diameter 23.5 mm
- Overall yield 62.5%
- 3 pneumothorax
RADIAL PROBE ULTRASOUND SPNs

Radial Probe

Image of a peripheral SPN
RADIAL PROBE ULTRASOUND
SPNs

• Rotating transducer at tip of probe
• Inserted through standard bronchoscopic channel
• Tissue penetration 4-5 cm
• Used primarily to visualize peripheral pulmonary nodules
• Remove the probe and pass the brush or forceps through the sheath
• Overall yield between 45-60%