Ultrasonography for Dummies

Thomas F. Morley, DO, FCCP, FACOI, FAASM
Professor of Medicine
Director of the Division of Pulmonary, Critical Care, and Sleep Medicine
UMDNJ/SOM
• Echocardiography and Ultrasound generally have been felt to be under the jurisdiction of either cardiology and radiology

• However recent technology has allowed for smaller, simpler and more portable US machines that can be used by internists, pulmonologists, ER physicians, and many other physicians without prolonged training.
• Many studies have shown that US can provide clinically relevant information that can be obtained by non-cardiologist or non-radiologists.

• US can be done real time at the bedside to provide information immediately that can provide a specific diagnosis and aide in determining specific treatments.

• US can be helpful in Improving safety and success of some invasive procedures (IV lines, thoracentesis)
Ultrasound in the ICU

- Central Line placement
- FAST examination
- Detection of DVT
- Differential cardiac mechanisms of Shock

Ultrasound for Staging of Lung Cancer

- EBUS
- EUS
US guided IJV cannulation

- Figure. Transcervical 2-Dimensional ultrasound short-axis image of the right internal jugular vein (IJV) and common carotid artery (CA) during cannulation with an 18 g needle. The anterior wall of the IJV is indented (double arrow) as the needle enters the vessel. The needle tip can be identified in the center of the vessel lumen (single arrow).
Focused Assessment with Sonography for Trauma

- **FAST** is a rapid bedside ultrasound examination performed by surgeons, physicians and certain paramedics as a screening test for blood around the heart (**pericardial tamponade**) or abdominal organs (**hemoperitoneum**) after **trauma**.

- The four areas that are examined for free fluid are the perihepatic space (also called Morison's pouch or the **hepatorenal recess**), perisplenic space, **pericardium**, and the **pelvis**. With this technique it is possible to identify the presence of intraperitoneal or pericardial free fluid. In the context of traumatic injury, this fluid will usually be due to **bleeding**.
Technique

- **Goal:** to identify blood in body cavities where it is not supposed to be
  - Unclotted blood appears black on US
  - Clotted blood appears gray

- **Abdominal probe with small footprint (between 1-3 cm) with range of frequency between 2.0 Hz and 5.0 Hz**

- **Scan 4 areas**
  - RUQ
  - Subxiphoid
  - LUQ
  - Suprapubic
Normal RUQ FAST
MVA patient – RUQ View
Hemothorax
Normal LUQ
Hemoperitoneum - LUQ
Suprapubic View
LLQ with + HCG = Ectopic Pregnancy
Pelvic US - Suprise
Never underestimate the power of stupid people in large groups.
US for Diagnosis of DVT

Radiology Rounds
A Newsletter for Referring Physicians
Massachusetts General Hospital
Department of Radiology
### US for Diagnosis of DVT

<table>
<thead>
<tr>
<th>Medical Imaging</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>Compression Ultrasound</td>
<td>93%</td>
<td>98%</td>
</tr>
<tr>
<td>MR Venography</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>CT Venography</td>
<td>89-100%</td>
<td>94-100%</td>
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</table>
Right lower extremity (A) transverse and (B) saggital images from color Doppler ultrasound demonstrates blood flow in the femoral artery but not in the common femoral vein (arrows). This is an indirect finding that suggests common femoral DVT.
US for Dx of DVT

- Is portable
- Can be performed by house staff at the bedside during off hours for US techs
- Is most useful when it is clearly positive or negative
- In other cases US techs can help
- Additional studies or serial LE US can be used.
Have a seat, Mr. Frog... these X-rays may come as a shock to you...
Cardiac Exam

Goal-Directed for SHOCK

• SHOCK: Is there a “global” cardiac cause?
• What are they?
  – Severe LV dysfunction (ventricular failure)
  – Severe underfilling of the LV (hypovolemia/RV failure, ie RV infarct)
  – Severe RV dysfunction, severe RV pressure overload ie Massive PE
  – Tamponade / collapse of chambers
Orienting the transducer

- A. Parasternal long axis the transducer is aimed from right shoulder towards the apex
- For the parasternal short axis the transducer is rotated to horizontally section the RV and LV
Patient Positioning

Lateral decubitus for parasternal, and apical 4C

Left arm raised to open interspaces

Flat with knees raised and bent for subcostal
Parasternal long-axis (PLA) view

The probe should be placed in the parasternal fourth or fifth intercostal space with the transducer indicator directed pointed to the patient's right shoulder, as shown below.

This allows for typical identification of the right ventricle, left atrium, left ventricle, aortic valve, aortic root, aortic outflow tract, and surrounding pericardium.

The right atrium is typically not visualized on the PLA view.
To see more of the base of the heart (ie, aortic root) try dragging the probe cephalad one intercostal space.
To see more of the apex, try dragging the probe laterally toward the midclavicular line.
Parasternal Long Axis View
Parasternal Long Axis View
Parasternal short-axis view

From the PLA position, rotate the probe clockwise 90° such that the probe indicator is pointed toward the patient's left shoulder, as shown.

This allows for identification of the left ventricle, right ventricle, and pericardium. In this view, the right ventricle is closer to the surface and appears crescent-shaped, while the left ventricle is deep to the right ventricle and appears circular.
Parasternal Short Axis View

Tilt the transducer up
To see the aortic valve

Tilt the transducer down
To see the LV

© Images Paediatr Cardiol
The parasternal short axis view has 4 levels:

aortic valve, mitral valve, papillary muscles, and apex.

Sweep or fan the probe up toward the patient's right shoulder and down toward the patient's left hip to scan through all 4 levels. Each level provides unique information.
Left Parasternal Short Axis

Short axis planes - superior
In terms of assessing global left ventricle function, the papillary muscle level typically is the most useful, as this is a midventricle view.
Parasternal Short Axis View
Mitral Valve Level
Parasternal Short Axis View
Papillary muscles level
Parasternal Short Axis View
Aortic valve level

1. RV cavity; 4. Aortic valve; 9. LA
11. TV; 12; RA 13; RV outflow tract;
14; PV; 15. PA
Apical 4-chamber view

If possible, have the patient raise the left arm up over his or her head to try and spread the ribs.

Palpate for the cardiac point of maximal impulse (PMI) and place the probe there with the indicator pointed toward the left axilla and the probe in a coronal plane relative to the heart, as shown, aimed toward the base of the heart.

This allows for identification of the left ventricle, right ventricle, left atrium, right atrium, and pericardium.
Apical four-chamber view (A4C)
Subxiphoid - 4 Chamber View

Placement of probe for subxiphoid 4-chamber view. Once the probe is placed in the subxiphoid area, identify the inferior vena cava (IVC) and then sweep upward so that the probe is aimed at the left shoulder.

Follow the IVC up until it is seen entering the right atrium.
Subcostal or Subxiphoid Four-chamber view

1. RV; 3. LV; 7. MV; 9. LA; 12. RA; 21. Liver
Assessment of Fluid Status

• Indirect signs of Severe Hypovolemic
  – Dynamic LV Obstruction
  – Systolic obliteration of LV cavity

• It would be helpful to be able to identify which shock patients will respond to volume
Relation Between IVC/RA junction and Central Venous Pressure (CVP)
Adapted from Jones Handbook of Ultrasound in Trauma and Critical Care Illness, 2003 (9).

<table>
<thead>
<tr>
<th>IVC measured</th>
<th>Percent collapse (IVC) during inspiration</th>
<th>CVP (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.5 cm</td>
<td>&gt;50%</td>
<td>0-5</td>
</tr>
<tr>
<td>1.5-2.5 cm</td>
<td>&gt;50%</td>
<td>5-10</td>
</tr>
<tr>
<td>1.5-2.5 cm</td>
<td>&lt;50%</td>
<td>10-15</td>
</tr>
<tr>
<td>&gt;2.5 cm</td>
<td>Little phasicity</td>
<td>15-20</td>
</tr>
</tbody>
</table>
Indirect assessment of circulating volume status on 2D echocardiography by assessing diameter and change in caliber with inspiration of the inferior vena cava (IVC).

“Goal Directed Shock Exam”
4 MAIN ASSESSMENTS FOR SHOCK EXAM

• **LV size and function** (small or large, hyper or hypocontractile)

• **RV size and function** (small or large, hyper or hypocontractile)

• **Pericardial effusion** (absent or present, ? Chamber collapse)

• **Fluid Responsiveness** multiple measures to choose from in a passive patient on MV support (need some advanced skill for spontaneously breathing patients).
Measuring LV Function

- QUANTITATIVE – requires precise measurements – Let cardiology do it!

- Qualitative- global assessment – takes practice – make sure you are not off axis in view - reliable with experience

- Need to look at:
  - EXCURSION
    - NORMAL – 30 -50% movement of wall to a point in the center
  - THICKENING
    - NORMAL - 40% increase in wall thickness during systole
  - MUST see endocardium to reliably assess LV function
Wall Motion Scoring

• 1. Normal
  Normal inward movement and thickening > 30%

• 2. Hypokineti
  Restricted excursion and < 30% thickening

• 3. Akinetic
  Absent thickening

• 4. Dyskinetic
  Paradoxical (outward) movement during systole

• 5. Aneurysmal
  Diastolic wall abnormality: myocardium is thinned and hyper reflectant

** THICKENING is a better indicator of contractility than movement**
PSSAX

Normal LV Function

40% Excursion

40% Thickening
PSSAX

Impaired LV Function
Hypokinetic

10% Excursion
10% Thickening
A4C view

Impaired LV Function
Akinesia

Focal defect
A4C View

Impaired Function
Dyskinesia
Apical defect
PSSAX

Impaired Function
Global hypokinesia

Aneurysm of
Inferoposterior wall

Watch during diastole

What about the RV here?
Wall motion scoring is NOT GLOBAL ASSESSMENT

• Wall motion abnormalities can lead to shock but:

• Global Assessment should include:
  – 1. Global cardiac contractility (RV and LV)
  – 2. Pericardial effusion / Tamponade
  – 3. Relative chamber sizes (RV/LV size = 0.6)
  – 4. Volume status
Dilated Cardiomyopathy

Transthoracic examination of a severely dilated LV in the parasternal long-axis (left) and apical four-chamber (right) views in a 65-year-old patient who presented with flash pulmonary edema and who was later found to have severe diffuse coronary artery disease.

Global Contractility
dilated cardiomyopathy

- A4C VIEW
- Global Hypokinesia
- Dilated LV
- RV hypokinetic
- Both atria enlarged
Global Contractility
dilated cardiomyopathy

- PSSA VIEW
- Global Hypokinesia
- Dilated LV
- RV ?
ECHO Findings in Shock States

<table>
<thead>
<tr>
<th>Shock</th>
<th>LV</th>
<th>RV</th>
<th>IVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic (systolic)</td>
<td>Hypokinetic-largelarge</td>
<td></td>
<td>Big no collapse</td>
</tr>
<tr>
<td>Cardiogenic (diastolic)</td>
<td>Hypertrophied – small cavity</td>
<td></td>
<td>Big No collapse</td>
</tr>
<tr>
<td>Hypovolemic</td>
<td>Hyperkinetic – small cavity</td>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>Obstructive (PE)</td>
<td></td>
<td>Hypokinetic – large cavity</td>
<td>Big No collapse</td>
</tr>
<tr>
<td>Obstructive (tamponade)</td>
<td></td>
<td>Diastolic collapse</td>
<td>Big No collapse</td>
</tr>
<tr>
<td>Distributive</td>
<td>Hyperkinetic – small cavity</td>
<td></td>
<td>Small With collapse</td>
</tr>
</tbody>
</table>
Conclusions

- Beside Echocardiography can provide non-invasive, immediate, clinically relevant information in critically ill patients.

- Although there is a significant learning curve, resident physician can obtain the necessary skill in a reasonable short period of time.
Endobronchial Ultrasound: an Overview

Thomas F. Morley, DO, FACOI, FCCP, FAASM
Professor of Medicine
Director of the Division of Pulmonary, Critical Care and Sleep Medicine
Types of EBUS

• Radial

• Convex Probe EBUS
Convex Probe EBUS

• CP-EBUS provides a view that is parallel to the shaft of the bronchoscope — the angle of view is 90 degrees and the direction of view is 30 degrees forward oblique.

• 7.5 MHz

• Color flow and Doppler features permit identification of vascular, ductular, and cystic structures. The major advantage of CP-EBUS is its ability to guide real-time sampling.
Linear EBUS has the ultrasound transducer incorporated at the distal end of the bronchoscope.
• Turns out that Ultrasound waves function the same as light and audible sounds waves do.

• That is changes in the frequency of ultrasound sound waves can be used to determine the velocity and direction of blood flow. (i.e. Doppler US).
Convex Probe EBUS

- EBUS-TBNA is performed under local anesthesia and conscious sedation in an outpatient setting.
- The EBUS scope is guided through the patient’s mouth and trachea and bronchi to locate lymph nodes.
Convex Probe EBUS

• Both the ultrasound image and conventional bronchoscopy image are displayed on the same monitor. The ultrasound image can be frozen, allowing the size of lesions to be measured in two dimensions. Doppler ultrasound is also possible, which helps identify blood vessels
EBUS needle in LN with Doppler
A) Computed tomography reveals enlargement of the mediastinal lymph node, #4R. B) The convex probe endobronchial ultrasound image in the Doppler mode demonstrates the relationship between lymph node #4R and the superior vena cava (SVC). C) Real-time transbronchial fine needles aspiration. The 22-gauge needle is shown within lymph node #4R.
Convex probe

A) Linear curved array ultrasonic transducer on the end of an ultrasonic puncture bronchoscope. Used to perform convex probe endobronchial ultrasound. B) The balloon sheath that surrounds the ultrasonic transducer is inflated with water. A 22-gauge needle used for real-time transbronchial fine needle aspiration extends from the bronchoscope.
Advantages of Convex Probe EBUS

- Benefit of using EBUS for evaluating the central airway is that the patient can potentially avoid having to undergo a more invasive surgical procedure and can eliminate the need for additional phases of testing.

- Because EBUS is performed under conscious sedation, patients recover quickly and can generally go home the same day.

- Lastly, the accuracy and speed of the EBUS procedure lends itself to rapid onsite pathologic evaluation. Pathologists can process and examine biopsy samples as they are obtained, and can request additional samples to be taken immediately if needed. This is important because the accurate diagnosis and staging of lung cancer is crucial for prognostic and therapeutic decision-making.
Indications for EBUS

- Lung cancer diagnosis and staging
- Distant metastasis of other known or unknown cancer types
- Lymphoma (benign or malignant disease of the lymph nodes)
- Other diseases
  - Tuberculosis
  - Sarcoidosis
  - Histoplasmosis (fungal disease)
Non-Invasive Staging: Radiology

- Standard CT: using > 10 mm as abnormal
  - sensitivity: ~ 60%
  - specificity: ~ 80%

- Integrated PET-CT:
  - improved staging and anatomic accuracy
  - sensitivity: ~ 84 – 90%
  - specificity: ~ 85 – 94%

- Perhaps even less accurate for:
  - early stage disease
  - re-staging

Dwamena et al, Radiology 1999; 213: 530
Antoch et al, Radiology 2003; 329:526
Chest 2003; 123: 137s
The major purpose of EBUS is to stage Lung Cancer

- Staging lung cancer requires that hilar and mediastinal lymph nodes be sampled.
- Not ALL lymph nodes can be reached by EBUS
## Regional Lymph Node Station Stations

1. Supraclavicular
2. Upper Paratracheal
3. Prevascular/Retrotracheal
4. Paratracheal
5. Subaortic
6. Paraortic
7. Subcarinal
8. Paraesophageal
9. Pulmonary ligament
10. Hilar
11. Interlobar
12. Lobar
13. Segmental
14. Subsegmental
Lung cancer - Lymph Node Map - Update

by Robin Smithuis

Radiology department of the Rijnland Hospital in Leiderdorp, the Netherlands

http://www.radiologyassistant.nl/en/4646f1278c26f
IASLC Lymph Node Stations
On the left a 3A node in the prevascular space. Notice also lower paratracheal nodes on the right, i.e. 4R nodes.
On the left we see 4R paratracheal nodes. In addition there is an aortic node lateral to the aortic arch, i.e. station 6 node.
4L. Left Lower Paratracheal
4L nodes are lower paratracheal nodes that are located to the left of the left tracheal border, between a horizontal line drawn tangentially to the upper margin of the aortic arch and a line extending across the left main bronchus at the level of the upper margin of the left upper lobe bronchus. These include paratracheal nodes that are located medially to the ligamentum arteriosum. Station 5 (AP-window) nodes are located laterally to the ligamentum arteriosum.
An image just above the level of the pulmonary trunk demonstrating lower paratracheal nodes on the left and on the right. In addition there are also station 3 and 5 nodes.
On the left an image at the level of the lower trachea just above the carina. To the left of the trachea 4L nodes. Notice that these 4L nodes are between the pulmonary trunk and the aorta, but are not located in the AP-window, because they lie medially to the ligamentum arteriosum. The node lateral to the pulmonary trunk is a station 5 node.
5. Subaortic nodes
Subaortic or aorto-pulmonary window nodes are lateral to the ligamentum arteriosum or the aorta or left pulmonary artery and proximal to the first branch of the left pulmonary artery and lie within the mediastinal pleural envelope.
6. Para-aortic nodes
Para-aortic (ascending aorta or phrenic) nodes are located anteriorly and laterally to the ascending aorta and the aortic arch from the upper margin to the lower margin of the aortic arch.
7. Subcarinal nodes
These nodes are located caudally to the carina of the trachea, but are not associated with the lower lobe bronchi or arteries within the lung.
On the right they extend caudally to the lower border of the bronchus intermedius. On the left they extend caudally to the upper border of the lower lobe bronchus.
Above: A station 7 subcarinal node to the right of the esophagus.
IASLC Lymph Node Stations

8 Paraesophageal nodes
These nodes are below the carinal nodes and extend caudally to the diaphragm.

Above: an image below the carina. of the esophagus a station 8 node.
9. Pulmonary ligament nodes

Pulmonary ligament nodes are lying within the pulmonary ligament, including those in the posterior wall and lower part of the inferior pulmonary vein. The pulmonary ligament is the inferior extension of the mediastinal pleural reflections that surround the hila.
10 Hilar nodes

Hilar nodes are proximal lobar nodes, distal to the mediastinal pleural reflection and nodes adjacent to the intermediate bronchus on the right. Nodes in station 10 - 14 are all N1-nodes, since they are not located in the mediastinum.
Mediastinoscopy

• Considered “gold standard”
  – sensitivity ~ 78 – 90%, specificity 100%
  – FN rate ~ 9-11%
• The downsides:
  – unable to reach all nodal stations
  • 5, 6, posterior 7, 8, 9
  – invasive (mortality 0.2%, morbidity up to 2.5%)
  – more expensive
  – non-operable candidates undergoing surgical procedure

• Mediastinum is + is up to 10% of patients with clinical stage 1 disease

• Only performed in 27% of patients undergoing lung CA surgery – nodal tissue obtained in 47%

The following nodal stations can be biopsied by cervical mediastinoscopy:

- the left and right upper paratracheal nodes (station 2L and 2R),
- left and right lower paratracheal nodes (station 4L and 4R),
- and the subcarinal nodes (station 7).

Station 1 nodes are located above the suprasternal notch and are not routinely accessed by cervical mediastinoscopy.
Conventional mediastinoscopy
Left upper lobe tumors may metastasize to the subaortic lymph nodes (station 5) and paraaortic nodes (station 6). These nodes cannot be biopsied through routine cervical mediastinoscopy.

Extended mediastinoscopy is an alternative for the anterior-second Interspace mediastinotomy which is more commonly used for exploration of mediastinal nodal stations. This procedure is far less easy and therefore less routinely performed than conventional mediastinoscopy.
Extended mediastinoscopy
Benefits of TBNA

- Most stations are accessible
- Couple staging with diagnostic bronchoscopy
- Safe
- Less invasive
- Less expensive
- Precludes surgery in up to 29%

Am J Respir Crit Care Med 2000; 161: 601
Problems with TBNA

• Underused
  – 12% of pulmonologists routinely use TBNA in evaluation of malignant disease
• training / fear / support
• Operator dependent
  – sensitivity ranges from 37 – 89%
• Failure to place the needle directly into the lesion
  – depends on LN size / station and experience
  – benefit of ROSE

Chest 1991; 100: 1668
Am Rev Respir Dis 1993; 147: 1251
Chest 1998; 114: 4
Endobronchial Ultrasound (EBUS)
Endoscopic Ultrasound with Fine Needle Aspiration can be performed of all the mediastinal nodes that can be assessed from the esophagus.

In addition the left adrenal gland and the left liver lobe can be visualized.

EUS particularly provides access to nodes in the lower mediastinum (station 7, 8 and 9).
Esophageal US for staging Lung Cancer

<table>
<thead>
<tr>
<th>Study (year)</th>
<th>No. of patients</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Accuracy (%)</th>
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<tr>
<td>Wallace 2001 [23]</td>
<td>121</td>
<td>87</td>
<td>100</td>
<td>—</td>
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<td>Gress 1997 [21]</td>
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<td>Silvestri 1996 [38]</td>
<td>27</td>
<td>89</td>
<td>100</td>
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</table>
Comparison of Endobronchial Ultrasound, Positron Emission Tomography, and CT for Lymph Node Staging of Lung Cancer

Yasufuku et al, Chest 2006; 130: 710

- 102 potentially resectable patients with known (96) / suspected (6) lung CA
- 147 mediastinal nodes, 53 hilar nodes

Table 4—Characteristics of CT, PET, and EBUS-TBNA in the Correct Prediction of Mediastinal Lymph Node Staging*

<table>
<thead>
<tr>
<th>Tests</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
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<tr>
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<td>76.9</td>
<td>55.3</td>
<td>37.0</td>
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<td>80.0</td>
<td>70.1</td>
<td>46.5</td>
<td>91.5</td>
<td>72.5</td>
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<tr>
<td>EBUS-TBNA</td>
<td>92.3</td>
<td>100</td>
<td>100</td>
<td>97.4</td>
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</table>
PET scan of a 63-year-old man with adenocarcinoma in the right upper lobe.

Yasufuku K et al. Chest 2006;130:710-718

©2006 by American College of Chest Physicians
Chest CT (left panels), EBUS scan (top right, D), cytology (center right, E), and dissected lower paratracheal lymph node (bottom right, F) obtained in the 63-year-old patient from Figure 1.

False + CT
False + PET
True - EBUS TBNA

Anthracotic lymph node

Yasufuku K et al. Chest 2006;130:710-718
# EBUS-TBNA Staging of Lung Cancer

Yasufuku K et al. Chest 2006;130:710-718

<table>
<thead>
<tr>
<th>Tests</th>
<th>True Positive</th>
<th>True Negative</th>
<th>False Positive</th>
<th>False Negative</th>
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<tr>
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<td>20</td>
<td>42</td>
<td>34</td>
<td>6</td>
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<tr>
<td>PET</td>
<td>20</td>
<td>54</td>
<td>23</td>
<td>5</td>
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<tr>
<td>EBUS-TBNA</td>
<td>24</td>
<td>76</td>
<td>0</td>
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</table>
Images of a 61-year-old man with adenocarcinoma in the right lower lobe with false-negative findings on EBUS-TBNA.

Yasufuku K et al. Chest 2006;130:710-718
EBUS-TBNA

- 572 nodes in 502 patients
  - patients confirmed by thoracotomy, VATS or clinical f/u
- Diagnosis in 535 of punctures (94%)
- No ROSE
- 37 non-diagnostic
  - sarcoid in 2, CA in 35 on surgical Bx
- Sens. 94%, Spec. 100%, PPV 100%
- No complications

Herth et al, Thorax 2006; 61: 795
EBUS in the Radiologically Normal Mediastinum

• 100 patients with NSCLC and CT with no mediastinal LN > 10mm: EBUS-TBNA of all identifiable nodes - surgical staging with med (15) or thoracotomy (85)
  – mean LN diameter: 8.1mm
  – 2 aspirates / node
  – CA seen in 19, missed in 2
• N0 □ N1 3, N2 13, N3 3
  – Sens 92.3%, Spec 100%, NPV 96.3%
  – could avoid surgery in 17%

Herth et al, Eur Respir J 2006; 28: 910
EBUS in the PET neg. Mediastinum

- 97 patients with known / suspected NSCLC and neg PET-CT in the Mediastinum

- EBUS-TBNA f/b surgical staging
  - mean diameter 7.9mm
  - + in 8 patients: N3 in 1, N2 in 5, N1 in 2
  - 1 additional patient found with N1 disease on surgical staging

Herth et al, Chest 2008; 133:887
Combined Endoscopic-Endobronchial Ultrasound-Guided Fine-Needle Aspiration of Mediastinal Lymph Nodes Through a Single Bronchoscope in 150 Patients With Suspected Lung Cancer


• **Methods:** Consecutive patients with a presumptive diagnosis of non-small cell lung cancer (NSCLC) underwent endoscopic staging by EBUS-TBNA and EUS-FNA through a single linear ultrasound bronchoscope. Surgical confirmation and clinical follow up was used as the reference standard.
Flow diagram of patients enrolled in the study and procedures performed.

150 patients enrolled

139 patients with proven non-small cell lung cancer

71 pts with malignant nodes

- EBUS:
  - diagnostic 65
  - negative 6

- EUS:
  - diagnostic 63

68 pts with non-malignant nodes

- EBUS:
  - false negative 0

- EUS:
  - false negative 0

Combined EUS-FNA and EBUS-TBNA for staging of Lung Cancer with a single EBUS Scope


Diagnostic Performance Characteristics of Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration and Endoscopic Ultrasound-Guided Fine-Needle Aspiration in 619 Nodes From 139 Patients With Suspected Cancer

<table>
<thead>
<tr>
<th>Sampling Approach</th>
<th>Nodes sampled # %</th>
<th>Sens for cancer detection (%)</th>
<th>Spec for cancer detection (%)</th>
<th>NPV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophageal</td>
<td>229 (37)</td>
<td>89</td>
<td>100</td>
<td>82</td>
</tr>
<tr>
<td>Endobronchial</td>
<td>390 (63)</td>
<td>91</td>
<td>100</td>
<td>92</td>
</tr>
<tr>
<td>Combined</td>
<td>619 (100)</td>
<td>96</td>
<td>100</td>
<td>96</td>
</tr>
</tbody>
</table>
Combined Endoscopic-Endobronchial Ultrasound-Guided Fine-Needle Aspiration of Mediastinal Lymph Nodes Through a Single Bronchoscope in 150 Patients With Suspected Lung Cancer


- **Conclusions:** The two procedures can easily be performed with a dedicated linear endobronchial ultrasound bronchoscope in one setting and by one operator. They are complementary and provide better diagnostic accuracy than either one alone. The combination may be able to replace more invasive methods as a primary staging method for patients with lung cancer.
• **Primary lung carcinoma: expected results**

• **Metanalysis:** A total of 11 studies with 1299 patients, who fulfilled all of the inclusion criteria, were considered for the analysis. No publication bias was found.

  – EBUS-TBNA had a pooled sensitivity of 0.93 (95% CI, 0.91–0.94) and a pooled specificity of 1.00 (95% CI, 0.99–1.00).

• The subgroup of patients who were selected on the basis of **CT or PET positive** results had higher pooled sensitivity (0.94, 95% CI 0.93–0.96) than the subgroup of patients without any selection of CT or PET (0.76, 95% CI 0.65–0.85) (p < 0.05).
Limitations of EBUS TBNA

- Learning curve
- – 30o view
- – extra-bronchial anatomy
- • 22ga needle
- • Can’t reach levels 5, 6, 8, 9 (or L adrenal)
- • Non-Dx does not mean negative
- • Hybrid imaging lesser quality image
- • Medicare removed the technical fee in 1/08
Limitations of EBUS TBNA

• Expensive
• May not be possible for all institutions to perform sufficient number of procedures to become competent
Underused
– 12% of pulmonologists routinely use TBNA in evaluation of malignant disease
  • training / fear / support
  • Operator dependent
  – sensitivity ranges from 37 – 89%
  • Failure to place the needle directly into the lesion
  – depends on LN size / station and experience
  – benefit of ROSE
Summary

- Endoscopic staging can reach almost all stations.
- Associated with minimal complications.
- EBUS-TBNA can obviate the need for surgery in up to 56% of patients.
- EUS-FNA: up to 68%.
- Real time guidance no substitute for good technique.
- Will likely be positioned as procedure of choice for initial (and possibly re-) staging.

Bauwens et al, Lung Cancer 2008