

Overview of Endobronchial Ultrasound

Ultrasound is a technology that uses high-frequency sound waves to create images of anatomical structures within the body.¹ The sound waves are sent into the body and translated into an image by computer.¹ Endobronchial ultrasound (EBUS) is ultrasound combined with endoscopy to obtain images in and around the bronchial tree or the lungs. EBUS allows the physician to see beyond the bronchial wall, to the diseased tissue, lymph nodes and/or lesions outside of the bronchial airways. Therefore, it can be used in the diagnosis of lung cancer, infections and other diseases that cause enlarged lymph nodes in the chest, and to evaluate lesions which cause airway invasion.²

There are currently two imaging modalities for EBUS including radial and curvilinear (also referred to as linear or convex).³ Radial ultrasound provides a 360-degree image of the airway wall and surrounding structures external to the airway, perpendicular to the insertion direction of the endoscope.³ Curvilinear ultrasound provides a 60-degree image of the airway wall and surrounding structures external to the airway, parallel to the insertion direction of the endoscope.

Curvilinear EBUS allows physicians to perform a technique known as transbronchial needle aspiration (TBNA) through a curvilinear EBUS bronchoscope. This scope allows for a needle to be inserted through the bronchoscope channel to biopsy lymph nodes or a suspicious lesion through the bronchial wall. The benefit of using this scope is that the needle can be viewed in real time on the video monitor, while simultaneously viewing the lymph nodes, or region of interest (external to the airway) under ultrasound, enabling physicians to more accurately guide the needle into the lymph node to obtain pathology samples. This procedure is a relatively new, minimally invasive and safe procedure that has been proven to be highly effective in the diagnosis and staging of lung cancer.³

History of Endobronchial Ultrasound

Bronchoscopy is a procedure commonly used for obtaining a diagnosis for lung conditions and staging lung cancer;⁴ however, most lung cancers involve lesions and lymph nodes, which are located outside the internal surface of the airway wall and beyond the endoscopic view of the bronchoscope.³ To obtain pathology samples from lymph nodes in the central region of the lungs, several methods have been utilized, prior to ultrasound-guided procedures, including surgical and non-surgical techniques.

The application of ultrasound within the lungs was first described in 1992.³ Ultrasound was explored as a diagnostic technique because expanding the view beyond the airways allowed physicians to target lymph nodes more precisely, improving the diagnostic capabilities of bronchoscopy.³ One particular advancement was the application of EBUS-TBNA, developed to obtain diagnostic samples from lymph nodes in the central regions of the lungs, as an alternative to traditional, more invasive procedures.

A conventional surgical technique that has been used to obtain tissue samples from central lymph nodes surrounding the lungs is known as mediastinoscopy.⁴ This procedure is performed by making an incision in the chest and inserting an instrument to extract samples.¹ Surgical techniques, while accurate, have the downside of being invasive, expensive, requiring general anesthesia,⁵ and having a potential risk of infection. An EBUS scope allows the physician to easily view difficult-to-reach areas and to access more lymph nodes for biopsy compared to conventional mediastinoscopy.²

¹ American Medical Association. Complete Medical Encyclopedia. "Bronchoscopy." Random House Reference. New York, New York; 2003.

² UC San Diego Medical Center. "Endobronchial Ultrasound." University of California, San Diego; 2006. Accessed July 16, 2009. <<http://health.ucsd.edu/specialties/pulmonary/procedures/endobronchial.htm>>

³ Gomez, Mario and Silvestri, Gerard A. "Endobronchial Ultrasound for the Diagnosis and Staging of Lung Cancer." Proceedings of the American Thoracic Society. Vol 6: 180 – 186. The American Thoracic Society. 2009.

⁴ MUSC Health. "Bronchoscopy." Medical University of South Carolina. 2009. Accessed July 16, 2009. <<http://www.muschealth.com/gs/TandPContent.aspx?PageID=P07743>>

Prior to the advent of EBUS, one of the non-surgical techniques commonly used to stage lung cancer, which is still used today, is transbronchial needle aspiration (TBNA). This procedure is performed “blindly,” meaning without real-time imaging. The pulmonologist or thoracic surgeon locates the lymph nodes only by his knowledge of anatomy and images previously obtained through CT scan images.⁵ This makes the procedure highly operator-dependent and therefore, diagnostic accuracy can range.⁵ EBUS-TBNA was created to overcome the difficulties of traditional TBNA including low diagnostic accuracy and difficulty accessing lymph nodes.⁶

How Endobronchial Ultrasound is Performed

Radial EBUS is performed by inserting an ultrasound miniature probe through the instrument channel of a standard bronchoscope. The physician moves the probe forward and backward throughout the airway to obtain images of the surrounding tissue, so the physician can assess the internal structure of the lesion, determining its size, location, and depth of penetration.

EBUS-TBNA is performed under local anesthesia and conscious sedation in an outpatient setting.³ During the procedure, a special bronchoscope fitted with an ultrasound transducer and a needle is guided through the patient’s mouth and trachea to locate lymph nodes.² Once the physician locates the lymph nodes utilizing the ultrasound image, the physician can perform real-time guided needle aspiration to obtain a sample – without having to make any incisions.² The sample is sent to pathology to determine the diagnosis and staging of lung cancer.

Advantages of Endobronchial Ultrasound

Radial ultrasound allows for a 360-degree view of the exact location of a lesion in relation to the airway. This allows for more direct and accurate sampling, increasing the diagnostic yield of the procedure.⁶ The downside to using a radial probe is that the device must be removed from the bronchoscope channel before other sampling tools can be inserted; therefore, the physician loses the ability to view both the endoscopic and ultrasound images simultaneously while performing the biopsy, which can increase the chance of missing the target site or can reduce the specimen yield.⁶ The disadvantage of radial ultrasound highlights the advantages of the EBUS scope equipped with curvilinear ultrasound.

Curvilinear EBUS offers the advantage of simultaneously obtaining the diagnosis and stage of lung cancer in a single procedure in the outpatient setting.³ Using EBUS as a diagnostic tool has several benefits to the patient. The greatest 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.² In addition, because EBUS is performed under conscious sedation, patients recover quickly and can generally go home the same day.²

Lastly, the accuracy and speed of the EBUS procedure lends itself to rapid onsite pathologic evaluation.² 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.³

8/2009

⁵ Herth MD, Felix J.F., Krasnik MD, Mark, Yasufuku MD, Kazuhiro, Rintoul MD, Robert, and Ernst MD, Armin. “Endobronchial Ultrasound-guided Transbronchial Needle Aspiration.” J Bronchol. Vol 13, Number 2; April 2006.

⁶ Callaway Lane, Carol (RN, MSN ACNP-BC). “Endobronchial Ultrasound Guided Bronchoscopy: New Techniques in Daily Practice.” EndoNurse. December 2008.