TRANSBRONCHIAL NEEDLE ASPIRATION (TBNA)

Another procedure involves use of a hollow-bore needle passed through the bronchoscope for sampling of tissue adjacent to the trachea or a large bronchus. The needle is passed through the airway wall (transbronchial), and cellular material can be aspirated from mass lesions or enlarged lymph nodes, generally in a search for malignant cells. Mediastinoscopy has been considered the gold standard for mediastinal staging; however, transbronchial needle aspiration (TBNA) allows sampling from the lungs and surrounding lymph nodes without the need for surgery or general anesthesia.

ENDOBRONCHIAL ULTRASOUND (EBUS)–TRANSBRONCHIAL NEEDLE ASPIRATION (TBNA)

Further advances in needle aspiration techniques have been accomplished with the development of endobronchial ultrasound (EBUS). The technology uses an ultrasonic bronchoscope fitted with a probe that allows for needle aspiration of mediastinal and hilar lymph nodes guided by real-time US images. EBUS allows sampling of mediastinal lymph nodes and masses under direct vision to better identify and localize peribronchial and mediastinal pathology and offers access to more difficult-to-reach areas and smaller lymph nodes in the staging of malignancies. EBUS-TBNA has the potential to access the same paratracheal and subcarinal lymph node stations as mediastinoscopy, but also extends out to the hilar lymph nodes (levels 10 and 11). The usefulness of EBUS for clinical indications other than lung cancer is improving and has been recommended in the evaluation of mediastinal masses of unknown origin early in the diagnostic process.

EMERGING BRONCHOSCOPIC TECHNIQUES

Emerging techniques that can be performed using bronchoscopy include video/autofluorescence bronchoscopy (AFB), narrow band imaging (NBI), optical coherence tomography (OCT), and endomicroscopy using confocal fluorescent laser microscopy (CFM). AFB uses bronchoscopy with an additional light source to screen high-risk individuals and identify premalignant lesions (airway dysplasia) and carcinoma in situ. NBI capitalizes on the increased absorption of blue and green wavelengths of light by hemoglobin to enhance the visibility of vessels of the mucosa and differentiate between inflammatory versus malignant mucosal lesions. CFM uses a blue laser to induce fluorescence, and its high degree of resolution provides a real-time view of living tissue at an almost histologic resolution. OCT uses near-infrared light source and has spatial resolution advantages over CT and MRI. It can penetrate the airway wall up to three times deeper than CFM and is less susceptible to motion artifacts from cardiac pulsation and respiratory movements. However, careful assessment is required before these methods find a place in the evaluation strategy of early lung cancer and other lung diseases.

THERAPEUTIC BRONCHOSCOPY

The bronchoscope may provide the opportunity for treatment as well as diagnosis. A central role of the interventional pulmonology (IP) physician is the performance of therapeutic bronchoscopy. For example, an aspirated foreign body may be retrieved with an instrument passed through the bronchoscope (either flexible or rigid), and bleeding may be controlled with a balloon catheter similarly introduced. Newer interventional techniques performed through a bronchoscope include methods for achieving and maintaining patency of airways that are partially or completely occluded, especially by tumors. These techniques include laser therapy, cryotherapy, argon plasma coagulation, electrocautery, balloon bronchoplasty and dilation, and stent placement. Many IP physicians are also trained in performing percutaneous tracheotomy.

MEDICAL THORACOSCOPY

Medical thoracoscopy (or pleuroscopy) focuses on the diagnosis of pleural-based problems. The procedure is performed with a conventional rigid or a semi-rigid pleuroscope (similar in design to a bronchoscope and enabling the operator to inspect the pleural surface, sample and/or drain pleural fluid, or perform targeted biopsies of the parietal pleura). Medical thoracoscopy can be performed in the endoscopy suite or operating room with the patient under conscious sedation and local anesthesia. In contrast, video-assisted thoracoscopic surgery (VATS) requires general anesthesia and is only performed in the operating room. A common diagnostic indication for medical thoracoscopy is the evaluation of a pleural effusion or biopsy of presumed parietal pleural carcinomatosis. It can also be used to place a chest tube under visual guidance, or perform chemical or talc pleurodesis, a therapeutic intervention to prevent a recurrent pleural effusion (usually malignant) or recurrent pneumothorax.

The increasing availability of advanced bronchoscopic and pleuroscopic techniques has motivated the development of IP programs. IP can be defined as "the art and science of medicine as related to the performance of diagnostic and invasive therapeutic procedures, that which require additional training and expertise beyond that which required in a standard pulmonary medicine training program." IP physicians provide alternatives to surgery for patients with a wide variety of thoracic disorders and problems.

SURGICAL TECHNIQUES FOR OBTAINING BIOLOGIC SPECIMENS

Evaluation and diagnosis of disorders of the chest commonly involve collaboration between pulmonologists and thoracic surgeons. Although procedures such as mediastinoscopy, VATS, and thoracotomy are performed by thoracic surgeons, there is overlap in many minimally invasive techniques that can be performed by a pulmonologist, an interventional pulmonologist, or a thoracic surgeon.

MEDIASTINOSCOPY AND MEDIASTINOTOMY

Proper staging of lung cancer is of paramount concern when determining a treatment regimen. Although CT and PET scanning are useful for determining the size and nature of mediastinal lymph nodes as part of the staging of lung cancer, tissue biopsy and histopathologic examination are often critical for the diagnosis of mediastinal masses or enlarged mediastinal lymph nodes. The two major surgical procedures used to obtain specimens from masses or nodes in the mediastinum are mediastinoscopy (via a suprasternal approach) and mediastinotomy (via a parasternal approach). Both procedures are performed under general anesthesia by a qualified surgeon. In the case of suprasternal mediastinoscopy, a rigid mediastinoscope is inserted at the suprasternal notch and passed into the mediastinum along a pathway just anterior to the trachea. Tissue can be obtained with biopsy forceps passed through the scope, sampling masses or nodes that are in a paratracheal or pretracheal position (levels 2R, 2L, 3, 4R, 4L). Aortopulmonary lymph nodes (levels 5, 6) are not accessible by this route and thus are commonly sampled by parasternal mediastinotomy (the Chamberlain procedure). This approach involves a parasternal incision and dissection directly down to a mass or node that requires biopsy.

As an alternative to surgery, a bronchoscope can be used to perform TBNA to obtain tissue from the mediastinum, and, when combined with EBUS, can allow access to the same lymph node stations associated with mediastinoscopy, but also extend access out to the hilar lymph nodes (levels 10, 11). Finally, endoscopic ultrasound (EUS)–fine-needle aspiration (FNA) is a second procedure that complements EBUS-FNA in the staging of lung cancer. EUS-FNA is performed via the esophagus and is ideally suited for sampling lymph nodes in the posterior mediastinum (levels 7, 8, 9). Because US imaging cannot penetrate air-filled spaces, the area directly anterior to the trachea cannot accurately be assessed and is a "blind spot" for EUS-FNA. However, EBUS-FNA can visualize the anterior lymph nodes and can complement EUS-FNA. The combination of EUS-FNA and EBUS-FNA is a technique that is becoming an alternative to surgery for staging the mediastinum in thoracic malignancies.

VIDEO-ASSISTED THORACOSCOPIC SURGERY

VATS has become a standard technique for the diagnosis and management of pleural as well as parenchymal lung disease. This procedure is performed in the operating room using single-lung ventilation