Thoracoscopy and Video-Assisted Thoracic Surgery in the Treatment of Lung Cancer*

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The contemporary surgical repertoire for the evaluation and treatment of patients with lung cancer includes the bronchoscope, mediastinoscope, thoracoscope, and standard surgical instrumentation. The recent advances in video optics and the development of endoscopic instruments have significantly expanded the surgical options for patients with lung cancer. Thoracoscopy, or the more inclusive term of video-assisted thoracic surgery (VATS), has been characterized as "minimally invasive" surgery. Thoracoscopy and VATS have decreased operative trauma and facilitated surgical staging prior to neoadjuvant therapy. An ancillary benefit to diminished surgical morbidity is shorter hospital stays with a concomitant reduction in costs to the patient and health-care system. These advantages make VATS ideal for elderly patients or patients with significant comorbidity.

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In the past 70 years, a variety of surgical instruments have been used in the evaluation and treatment of patients with lung cancer. The thoracoscope has been used in the diagnosis and treatment of chest diseases since the report by Jacobaeus1 in 1922. Initial use of the thoracoscope focused on the drainage of postobstructive empyemas and the diagnosis of malignant pleural effusions. The mediastinoscope was first used to diagnose diseases in the mediastinum;2 its application in the diagnosis of metastatic lung cancer was noted by Harken and colleagues3 in their initial report. Both the utility of these instruments and the surgical repertoire were expanded with the development of video optics and endoscopic surgical instrumentation.4 Today the surgical repertoire includes the bronchoscope, mediastinoscope, thoracoscope, and standard thoracotomy instrumentation.

The most common form of mediastinoscopy is cervical mediastinoscopy.5 This procedure is performed through a suprasternal notch incision that provides access to all paratracheal lymph nodes (Fig 1). Cervical mediastinoscopy biopsy of both the left and right peritracheal lymph nodes (levels 2, 4, and 10) permits the staging of both IIIA and IIIB lung cancers. Standard cervical mediastinoscopy allows only limited access to the aortopulmonary (AP) window lymph nodes (levels 5 and 6). Alternative approaches to the AP window include anterior mediastinotomy (Chamberlain procedure) or extended mediastinoscopy.6 Both cervical and anterior mediastinoscopic incisions can be used to access the pleural space. Transpleural mediastinoscopy is particularly useful in diagnosing paravertebral or apical pleural masses.

Thoracoscopy provides access to all structures in the ipsilateral hemithorax. Thoracoscopy implies a transpleural approach requiring split-lung ventilation for adequate visualization. Because of the rigidity of the chest wall, CO2 insufflation is not required and may dangerously elevate intrathoracic pressures. In most cases, thoracoscopy is performed through small "access ports" limited to the size of a thoracoscopic trocar. A variety of accessory surgical instruments developed for use through the standard thoracosopic trocar permits effective resection of lung tissue as well as ligation of vessels and airways. In addition to accessing the entire lung, thoracoscopy provides access to hilar and ipsilateral peritracheal lymph nodes. The particular advantage of left thoracoscopic procedures is visualization of the left pulmonary hilus and AP window.

The use of the thoracoscope in combination with standard surgical instruments has led to the designation video-assisted thoracic surgery (VATS),7 which provides the same access to the hemithorax as both thoracoscopy and thoracotomy. The incision length in a VATS procedure, however, may vary between the short incision used with access ports and the larger incision used in posterolateral thoracotomies. In most cases, VATS requires single-lung ventilation provided by either a double-lumen endotracheal tube or bronchial blocker. VATS is typically performed with a combination of thorascopic and conventional

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Multimodality Therapy of Chest Malignancies: Update '94

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surgical instruments.

The development of video-assisted thoracic procedures has significantly expanded the number of surgical options for the staging and treatment of patients with lung cancer. The primary benefit of video thoracoscopy is a decrease in surgical trauma from “minimally invasive procedures,” including surgical staging procedures, which has reinforced the feasibility of these procedures prior to neoadjuvant therapy. An ancillary benefit to diminished surgical morbidity is shorter hospital stays with a concomitant reduction in costs to the patient and health-care system.

**MINIMALLY INVASIVE SURGERY**

Although thoracoscopic and video-assisted surgery is not painless, early evidence suggests there is significantly less pain associated with thoracoscopic procedures than with posterior lateral thoracotomies. Although it is difficult to compare subjective sensations like pain, a topographic and visual analogue scale assessment of pain in more than 1,000 patients visits after both thoracoscopy and thoracotomy indicates a significant difference between posterior lateral thoracotomy and a minimally invasive procedure (author [S.J.M.], unpublished data). Despite this improvement, local bruising and trauma to the intercostal nerve results in incisional soreness and anterior numbness.

The limited surgical trauma and potential for early ambulation after thoracoscopic or VATS procedures is ideal for elderly patients or patients with comorbidity. In a study of our first 100 patients older than 70 years undergoing such procedures, we found a complication rate of 7%: 5 patients had atrial arrhythmias, and 2 patients had prolonged air leaks (M. T. Jaklitsch, MD, unpublished data). There was one mortality in a patient who died of widespread metastatic disease documented at thoracoscopy.

Thoracoscopy and VATS have also lowered the psychological barrier among both patients and primary care physicians with regard to excising and treating small lung nodules. Today the standard of care is resection of nodules rather than observing them for evidence of growth. Especially in elderly patients with comorbidity, a minimally invasive procedure with limited surgical risk is preferable to simple observation of the lung nodule.

The disadvantage of thoracoscopy is the potential for a compromised procedure, ie, the resection of less lung tissue than would be considered optimal with an open thoracotomy. Recent studies by the Lung Can-

**FIGURE 1.** Schematic illustration of the mediastinal lymph nodes sampled during surgical staging of stage III lung cancer. Cervical mediastinoscopy (A) permits access to left and right paratracheal lymph nodes. Right thoracoscopy (B) provides access to the right paratracheal lymph nodes. Left thoracoscopy and anterior mediastinoscopy (C) permit access to aortico-pulmonary lymph nodes. The horizontal lines delineate lymph node groups used in lung cancer staging.
cer Study Group\(^8\) have demonstrated a 2.7-fold increase in local recurrence with limited resection. The potential disadvantage of thoracoscopy is the attractiveness of a limited resection based on technical considerations. A formal anatomic resection is considerably more demanding technically than a simple wedge excision. Although a number of comparative trials are ongoing, we believe that it is important that thoracoscopy, and the attractiveness of limited resections, not lead to compromised cancer operations.

The small skin incisions of thoracoscopic procedures have aroused speculation regarding the theoretic risks posed by these procedures. In the event of uncontrolled pulmonary arterial hemorrhage, for example, thoracotomy ports provide only limited access to the hilum. Much of this risk appears to be reduced with proper patient selection. In our center, patients who have hilar masses or who have undergone neoadjuvant therapy are not considered routinely for thoracoscopic resections of lung segments or lobes. Furthermore, the surgical approach is modified to provide reliable access to the hilum should unexpected hemorrhage occur. Another theoretic concern is the possibility of wound seeding during extraction of the resected lung cancer. In more than 600 thoracoscopic procedures, we have not observed any wound seeding from lung carcinoma. Careful patient selection and the insurance of adequate surgical margins have most likely contributed to this low incidence of wound recurrence.

**NEoadjuvant Therapy**

Rusch et al\(^9\) have shown the utility of thoracoscopic procedures in facilitating the anatomic assessment of lung cancers. In most cases, the thoracoscope can provide histologic assessment of ipsilateral N1 and N2 lymph nodes, pleural or chest wall disease, and additional lung parenchymal abnormalities.

The importance of careful intraoperative staging has been amplified with recent findings demonstrating the efficacy of neoadjuvant chemotherapy. In a randomized study of 60 patients, Roth et al\(^10\) have reported a significant benefit with neoadjuvant chemotherapy in patients with surgically staged conditions. This finding is consistent with other studies documenting the efficacy of neoadjuvant chemotherapy in patients with stage III lung cancer.\(^{11,12}\) An important consideration in this multimodality approach has been the anatomic assessment of T3 disease and the histologic evaluation of N2 disease. Particularly in patients with N2 disease, histologic evidence of nodal metastases is critical before initiating multimodality therapy. In many currently available protocols, patients with T2N2 non-small cell lung cancer are given two or three cycles of combination chemotherapy. Subsequent surgery, with careful restaging of mediastinal lymph nodes, provides an important histologic assessment of the efficacy of the neoadjuvant approach. Because the patient is subjected to two surgical procedures, it is important that the initial surgical staging procedure is well tolerated and does not further delay therapy. We typically perform outpatient mediastinoscopy in patients with suspected N2 disease. Thoracoscopy is a useful complement to mediastinoscopy in the anatomic assessment of chest wall invasion and mediastinal nodal disease.

**Cost Containment**

Thoracoscopy and VATS lessen surgical morbidity and, as a consequence, facilitate the early discharge of patients from the hospital. Patients undergoing thoracoscopic evaluation of pleural disease, chest wall invasion, or mediastinal masses are typically discharged from the hospital within 24 h of the procedure. Similarly, patients undergoing resection of peripheral lung nodules are typically discharged from the hospital the following morning. Anatomic lung resections such as segmentectomies and lobectomies performed using video-assisted techniques are commonly associated with hospital stays of 2 or 3 days. With the reduction of pain and atelectasis, the primary determinant for hospital discharge has been persistent air leaks and prolonged chest tube drainage. As improved surgical techniques and lung stapling devices are developed, we anticipate that short hospitalizations will be commonplace, even in patients with parenchymal lung disease.

**Conclusion**

The combination of mediastinoscopy, thoracoscopy, and VATS has significantly expanded the number of surgical options for the staging and treatment of patients with lung cancer. The minimal surgical trauma associated with mediastinoscopy and thoracoscopy has reinforced the feasibility of surgical staging procedures prior to neoadjuvant therapy. An additional benefit to diminished surgical morbidity is less postoperative discomfort and shorter hospital stays for the patient. Despite the advantages of minimally invasive surgery, care must be taken to avoid compromised cancer operations.

**References**

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