Video-Assisted Thoracic Surgery: Applications and Outcome

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ABSTRACT

Thoracoscopy has been revived and expanded by recent improvements in endoscopic technology. The enhanced application and outcome of VATS (video assisted thoracic surgery) was retrospectively studied. Between 1992 and 1995, 82 patients underwent diagnostic thoracoscopy or interventional VATS. Indications included: shortness of breath with nonspecific x-ray abnormality (45%), pulmonary nodule (25%), pleural effusion/empyema (21%), pneumothorax (14%), and hemoptysis, chronic cough or lung consolidation (5%). Sixty-six (83%) of the procedures were completed thoracoscopically. Eight procedures (10%) required addition of a utility mini-thoracotomy and 6 procedures (7%) were converted to formal thoracotomy. Specific diagnostic and/or therapeutic applications of VATS included: inspection; lysis of adhesions; stapling of blebs; biopsy of lung, pleura, or mediastinal structures; drainage and decortication of empyema; mechanical and chemical pleurodesis; wedge resection; and segmental resection.

Diagnosis was established and/or treatment completed in 95% of cases. Pathologic diagnoses included: interstitial pneumonitis (22%), cancer (19%), bullous disease (15%), cocci nodule (9%), and other (18%). There were twenty-two complications (28.9%) and four deaths (4.8%). All four deaths were from causes unrelated to the surgery. The most common complications were: residual pneumothorax or hydrothorax (7), failed pleurodesis (3), and prolonged incisional pain (2).

The advantage of reduced chest wall and muscle trauma utilizing VATS as opposed to traditional thoracotomy translates to less patient discomfort. The excellent magnified visualization afforded by VATS offers the opportunity to successfully conduct diagnostic and therapeutic interventions in the chest with equal or better visibility. Our findings suggest that the applicability and success of VATS is greatly expanding and its complication rate is less or, at worst, comparable to traditional thoracotomy.

Key Words: Thorascoscopy, Video assisted thoracic surgery (VATS)

INTRODUCTION

Less than a decade ago, the introduction of video technology and endoscopic staplers revolutionized thoracoscopy, which was initially introduced as a diagnostic tool early in the century. The less invasive nature of thoracoscopy and associated video-assisted thoracic surgery (VATS) has resulted in an altered practice pattern among referring physicians.[1] Patients who would previously have been observed with serial radiographs or subjected to fine needle biopsy are now referred for VATS. The rapid acceptance of VATS by the surgical community was both due to the compelling advantages of the new technology, and the pressure imposed on surgeons by equipment manufacturers and patients alike.[2] Our combined experience from three community teaching hospitals is presented in this report.

MATERIALS AND METHODS

Between 1992-1995, 82 patients underwent VATS and were retrospectively reviewed. Fifty-six were males and 26 were females. Age ranged between 15-87 years. Fifty-two patients were older than 60. Indications for VATS were shortness of breath (45%); pulmonary nodules (25%); pleural effusion (21%); spontaneous pneumothorax (14%); and hemoptysis, chronic cough, and consolidation, collectively (5%). VATS was used for inspection, lysis of adhesions, biopsy, stapling of blebs, wedge resection, segmental resection, decortication, drainage of empyema, and chemical and mechanical pleurodesis. All procedures were performed under general anesthesia with a double lumen endotracheal tube. The patient is placed in a posterolateral thoracotomy position with the side to be explored positioned up. The first port is placed in the mid-axillary line at the 5th-6th intercostal space followed by a second port in the mid-axillary line at the 2nd-3rd intercostal space. Two more ports are occasionally placed in line with the lower port in the anterior and posterior axillary line. The port sites can be connected if conversion to formal thoracotomy is required. CO_2 insufflation is used if the lung cannot be collapsed in a timely manner.

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Table 1.
Complications

COMPLICATIONS	PATIENTS	PERCENTAGE
Residual pneumothorax and/or hydrothorax	7	9.2
Failure of pleurodesis	3	3.9
Incisional pain	2	2.6
Anemia	2	2.6
Subcutaneous emphysema	1	1.3
Elevation of the diaphragm	1	1.3
Hemoptysis	1	1.3
Wound infection	1	1.3
Atrial fibrillation	1	1.3
Ventricular fibrillation	1	1.3
Atelectasis	1	1.3
Diaphragmatic perforation	1	1.3
TOTAL	22	28.9

RESULTS

Sixty-six operations (83%) were completed thoracoscopically, eight patients (10%) required a utility incision (VATS) to expedite the procedure and six patients (7%) were converted to formal thoracotomy. Every patient had a diagnostic thoracoscopy with one or more additional procedures. Thirty-three patients had wedge resection with or without lysis of adhesions, drainage of pleural effusion, pleural biopsy, and pleurodesis. Thirty-eight patients underwent pulmonary, pleural, or mediastinal biopsies with or without lysis of adhesions, drainage of pleural fluid and pleurodesis. Ten patients had lysis of adhesions with or without drainage of pleural effusion and pleurodesis. Two patients underwent empyema drainage. Thoracoscopic lobectomy was completed in one patient for bronchiectasis, converted in one patient with cancer and in another patient with gunshot wound due to equipment failure. Median operative time was 60 minutes with a range of 15-240 minutes, compared to 145 minutes and a range of 50-205 minutes for those converted to formal thoracotomy. Median blood loss was 25 cc. with a range of 25-500 cc. compared to 300 cc. and a range of 25-500 cc. for the conversions. Median postoperative stay was three days with a range of 1-28 days compared to 4.5 days and a range of (1-22) days for the conversions. Four patients died in the hospital, with a mortality of 4.8%. All deaths were not related to the procedure. One patient died secondary to pneumocystis carnii pneumonia, two patients died of respiratory failure secondary to interstitial pneumonia, and advanced bullous disease. The cause of death in the fourth patient was never identified. No diagnosis was achieved in 14 patients (17%). Eleven patients had shortness of breath with nonspecific radiographic findings requiring ventilatory support. Workup with other modalities failed to achieve a diagnosis. Biopsies obtained through VATS showed nonspecific inflammatory changes. In retrospect, these patients had congestive heart failure that responded to medical therapy. Two patients had pulmonary nodules and one patient had a pleural nodule that were wedged out. Pathology showed nonspecific inflammatory changes. Pathologic diagnoses included: interstitial pneumonitis (22%), cancer (19%), bullous disease (15%), cocci nodules (9%) and pneumonia, empyema, carcinoid tumor, mesothelioma, obliterative bronchiolitis, asbestosis and thymoma, collectively (18%). Twenty-two patients (28.9%) suffered complications **(Table 1)**.

DISCUSSION

Within a relatively short period of time, VATS has become widely used in the diagnosis and treatment of many thoracic conditions. Its diagnostic accuracy is reported to be up to 97%.[3,4] Although diagnosis was achieved in only 83% of our cases, the ability to exercise therapeutic measures raised the number of patients who benefited from the pro-

cedure to 95%. In large series, VATS has a mortality of 0.07-0.5%, a non-fatal complication rate of 4.2-10.9%, and a conversion rate of 12.4%.[5,6] Our complication rate (29%) is clearly higher, probably secondary to our early work at the beginning of our learning curve. Shortness of breath with nonspecific x-ray changes was the main indication for VATS followed by solitary pulmonary nodules and pleural effusion, respectively. The superiority of VATS stems from the fact that it offers a magnified panoramic view of the hemithorax and provides the opportunity to lyse adhesions, drain fluid, take adequate biopsies, and to address concomitant pulmonary, pericardial, and mediastinal diseases.[7] In addition, it offers less postoperative pain and early return to daily activities.[8]

Some specific thoracic surgical problems for which VATS is, or promises to become, the surgical approach of choice include: pleurodesis, decortication of early empyema, excision of peripheral solitary pulmonary nodules, management of recurrent primary or secondary spontaneous pneumothorax, and stapling of bullae. Other less common indications for VATS include: access to anterior thoracic spine,[9] diagnosis of diaphragmatic injuries,[10] treatment of mediastinal lesions,[11] congenital cardiac lesions in pediatric population,[12,13] and sympathectomy.[6] For open lung biopsy, VATS is safe and effective, but it is more expensive than limited thoracotomy.[14] Twenty percent of patients with pleural effusion remain without specific diagnosis after thoracentesis and closed pleural biopsy.[15] In malignant effusions, traditional pleurodesis may lead to patchy adhesions, loculated fluid and trapped lung. VATS allows adequate mobilization of the lung with effective pleurodesis using either chemical, mechanical with or without limited pleurectomy,[16] or using only parietal pleurectomy.[17]

Early and intermediate stage empyema can be treated effectively with VATS. The pleural space can be debrided under direct vision, the lung evaluated for re-expansion, associated pathology evaluated, and decortication performed.[7] Early VATS avoids the chronic organizing phase of empyema.[18,19] Nevertheless, VATS can still be attempted in these cases as it can direct the proper site for open thoracotomy, should it fail.[19]

Although VATS has been successful in excising central pulmonary nodules,[20] it has become the diagnostic procedure of choice for peripheral nodules (nodules with close attachment to segmental and subsegmental bronchopulmonary units and/or with distance to visceral pleura less than 10 mm). Several methods have been used to localize solitary nodules. Wires and hooks have their complications. Staining with methylene blue has been found to be safe, effective and obviates wire-related complications.[19] However, extensive anthracotic pigmentation may interfere with proper localization.[21] A major concern is that both above-mentioned methods are associated with 33% pneumothorax, and 20% lung hemorrhage.[7,19]

A tactile sensor for thoracoscopic localization of pulmonary nodules has been developed. It can sense the presence of a nodule within 15 mm of the lesion by a sudden upward jump in the resonance frequency curve.[22] The application of VATS for excision of solitary nodules is justified by the fact that many nodules are benign. Of interest is the fact that 9% of the solitary pulmonary nodules in our series were caused by pulmonary coccidiomycosis. Should the nodule be malignant, visualizing the presence of extensive disease may obviate unnecessary thoracotomy.[1]

VATS is superior to open thoracotomy in managing recurrent spontaneous pneumothorax or persistent air leak (more than 5 days).[23] It is more so in primary spontaneous pneumothorax where the subpleural bullae can be adequately excised, and pleurodesis performed. An important benefit is the reduction in postoperative respiratory dysfunction.[23-25] In secondary spontaneous pneumothorax, VATS is less effective due to the patchy pleural adhesions, and multiple bullae, some of which may be missed leading to persistent air leak.[23] VATS is not superior to transaxillary mini-thoracotomy for apical bullae, but it has the advantage of providing an access to other lobes that may not be accessible with open procedure.[25, 26]

An important area of debate is the application of VATS for anatomical lung resection. It is associated with a potentially fatal complication of bleeding. Anatomical lung excision may require the development of a fissure, and in the case of cancer surgery, lymph node dissection may be tedious and time-consuming.[27] Tumor recurrence in the pleural cavity and at port sites is a known complication after VATS in spite of the use of sealed bags to remove the specimen.[28] The mechanism of tumor implantation remains unclear. Nevertheless, VATS can still be used in anatomical lung resection for non-malignant conditions, such as bronchiectasis.[29]

An evolving indication for VATS is lung reduction surgery. Traditionally, the surgery is performed on both lungs by median sternotomy. Unilateral lung reduction surgery by VATS has shown comparable, and in some cases lower, morbidity and mortality with similar improvement in pulmonary function,[30] except for patients with combination of hypercapnia and reduced single breath diffusing capacity for carbon monoxide, who constitute a considerable perioperative morbidity.[31]

In conclusion, the advantage of reduced chest wall and muscle trauma utilizing VATS as opposed to traditional thoracotomy translates to less patient discomfort. The excellent magnified visualization afforded by VATS offers the

opportunity to successfully conduct diagnostic and therapeutic interventions in the chest with equal or better visibility compared to open thoracotomy. Our findings suggest that the applicability and success of VATS is expanding and its complication rate is less or, at least, comparable to traditional thoracotomy.[32]

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