

# Surgical Strategy of Complex Empyema Thoracis

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## ABSTRACT

**Background:** The optimal treatment of empyema thoracis has been widely debated. Proponents of pleural drainage alone, drainage plus fibrinolytic therapy, video-assisted thoracoscopic surgical (VATS) debridement, and open thoracotomy each champion the efficacy of their approach.

**Methods:** This study examines treatment of complex empyema thoracis between June 1, 1994, and April 30, 1997. Twenty-one men and 9 women underwent 30 drainage/decortication procedures (14 open thoracotomies and 16 VATS) in treatment of their disease. Effusion etiology was distributed as follows: infectious - 14; neoplastic-associated - 7; traumatic - 3; other - 6.

**Results:** The mean preoperative hospital stay was  $14 \pm 8.8$  days, ( $11.4 \pm 6.5$  days for VATS vs  $16.8 \pm 10.2$  days for thoracotomy). Hospital stay from operation to discharge for thoracotomy patients was  $10.0 \pm 7.2$  days (median 8.5 days) and for VATS patients  $17.6 \pm 16.8$  days (median 11 days). These differences were not statistically significant. Duration of postoperative thoracostomy tube drainage was  $8.3 \pm 4.6$  days for thoracotomy patients and  $4.7 \pm 2.8$  days in the VATS group ( $p = 0.01$ ). Operative time for the thoracotomy group was  $125.0 \pm 71.7$  minutes, while the VATS group time was only  $76.2 \pm 30.7$  minutes. Estimated blood loss for the thoracotomy group was  $313.9 \pm 254.0$  milliliters and for the VATS group  $131.6 \pm 77.3$  milliliters. Three of the 30 patients (10.0%) required prolonged ventilator support (>24 hours). Morbidity included one diaphragmatic laceration (VATS group) and one thoracic duct laceration (thoracotomy). Two VATS procedures (6.7%) required conversion to open thoracotomy for thorough decortication.

**Conclusions:** The surgical approach to empyema thoracis is evolving. In the absence of comorbid factors, the significantly lower requirement for chest tube drainage time in the VATS patients suggests that this modality is an attractive alternative to thoracotomy in the treatment of complex empyema thoracis.

**Key Words:** Complex empyema thoracis, Video-assisted thoracoscopic surgery (VATS).

## INTRODUCTION

Treatment options for management of empyema thoracis have been recently reviewed by several groups.<sup>1-3</sup> While general agreement exists for treatment of thin, exudative effusions by simple thoracentesis or tube thoracostomy, controversy arises as to the optimal approach to diagnosis and treat the fibrinopurulent and organize phases of the disease. Early reports<sup>4</sup> suggesting use of VATS techniques to treat pleural empyema have only recently appeared in the literature.

Preoperative evaluation of empyema includes recognition of symptoms, chemical and microbiologic analysis of pleural fluid and radiographic investigation. A prolonged interval between hospital admission and institution of definitive therapy often occurs, thus allowing further organization of an already loculated cavity.

Classic treatment of empyema with repeated thoracentesis or tube thoracostomy is fraught with persistent inadequate thoracic drainage. This issue has been addressed from the pharmacological perspective with instillation of the fibrinolytic agent streptokinase to promote thrombus dissolution. Advances in thoracic radiology permit precise drainage catheter positioning with low attendant morbidity. Finally, refinement of VATS techniques facilitates a minimally invasive surgical access portal to the thorax for exploration, debridement and drainage.

The utility of VATS continues to evolve from a modality principally of pleural evaluation to an accepted means of definitive surgical treatment of complex intrathoracic pathology. This study group examines a series of patients with complex empyema thoracis. A comparison

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of preoperative diagnostic modalities, etiology of the disease, method of treatment and postoperative care is analyzed to determine if VATS is a viable treatment alternative to open thoracotomy.

## METHODS

### Patient Selection

This study is a review of all surgically treated cases of empyema thoracis performed at either the University of Illinois at Chicago Hospital or the Veterans Administration Westside Medical Center by one surgeon (WTV) between June 1, 1994, and April 30, 1997. All patients treated by the thoracic surgical service during this time period were included in the study group. A total of 30 patients with complex empyema thoracis in 9 women and 21 men were treated. The open thoracotomy group consisted of 14 patients, 12 men and 2 women, with an average age of 50.9 years (range 27-74 years). The VATS group consisted of 16 patients, 9 men and 7 women, with an average age of 51.6 years (range 27-73 years) (**Table 1**).

All cases were evaluated and managed preoperatively by the general medical service. Chest radiography was uniformly performed; computed tomography was obtained in 25 patients. Thoracentesis was performed in 22 patients (10/14 in the open group and 12/16 in the VATS group); all studies were done by either the medical or pulmonary service. Preoperative bronchoscopy was done in only six patients. The time between hospital

admission and surgical intervention was determined by when the medical service requested a surgical consultation. Once consulted, most patients underwent decortication the following day. Average preoperative hospital stay was  $13.9 \pm 8.8$  days,  $11.4 \pm 6.5$  days for the VATS group and  $16.8 \pm 10.2$  days for the thoracotomy group (**Table 2**).

### Operative Procedure

All patients underwent general endotracheal anesthesia with a double lumen tube to facilitate single-lung ventilation. Thoracic epidural infusion catheters were placed in 26 (86.7%) patients for management of visceral pain that generally accompanies parietal pleural stripping from the inner surface of the thoracic cavity. Open thoracotomy patients underwent a serratus muscle-sparing lateral thoracotomy. Those patients undergoing VATS had placement of three 10-mm ports, most often one in the anterior, mid and posterior axillary line to form a triangle whose apex was directed toward the anterior superior iliac spine.

Debridement of the visceral and parietal pleural surfaces was performed bluntly with ring forceps or a metal-tipped suction and sharply with endoscopic or conventional scissors. Inadequate VATS visualization of the thoracic cavity required conversion to an open procedure in two patients (6.7%). Two – 32 French thoracostomy drainage tubes were placed under direct vision prior to wound closure.

All patients were managed postoperatively by the thoracic surgical service. Criterion for thoracostomy tube removal in both groups was the absence of an air leak and less than 50 mL of drainage during the preceding 24 hours. Patients not ready for discharge from the hospi-

**Table 1.**  
Patient Demographics.

	Group	
	Open Thoracotomy	VATS
Number of Patients	14	16
Sex Distribution	12 male:2 female	9 male:7 female
Average Age	50.9 years	51.6 years
Preop hospital stay	$16.8 \pm 10.2$ days	$11.4 \pm 6.5$ days
Etiology		
Infectious	6	8
Neoplastic	2	5
Traumatic	2	1
Other	4	2

**Table 2.**  
Preoperative Evaluation.

	Group	
	Open Thoracotomy	VATS
Chest Radiograph	14/14	16/16
Computed Tomography	12/14	13/16
Thoracentesis	10/14	12/16
Bronchoscopy	01/14	05/14

tal after chest tube removal due to other comorbid conditions were transferred back to their referring service.

**Statistics**

Comparison of group means was performed using the Student's paired t-test with  $p < 0.05$  considered as significant.

**RESULTS**

Twenty-one men and 9 women underwent 30 drainage/decortication procedures (14 open thoracotomies and 16 VATS) in treatment of their disease. Effusion etiology was distributed as follows: infectious (as defined by pH and glucose parameters from thoracentesis specimens) - 14; neoplastic-associated - 7; traumatic - 3; other (effusions with a negative culture result and not meeting the pH and glucose parameters for classification as "infectious") - 6. Culture results in the patients with infectious empyemas included negative culture - 6, *Strept. Pneumoniae* - 4, *Staph. Aureus* - 2, *Pseudomonas aeruginosa* - 2. Neoplasms encountered included lung (primary), breast, kidney, and mesothelioma.

Mean duration of hospital stay from operation to discharge for thoracotomy patients was  $10.0 \pm 7.2$  days (median 8.5 days) and for VATS patients  $17.6 \pm 16.8$  days (median 11 days,  $p = 0.26$ ). Duration of postoperative thoracostomy tube drainage was  $8.3 \pm 4.6$  days for thoracotomy patients and  $4.7 \pm 2.8$  days in the VATS group ( $p = 0.01$ ). Operative time for the thoracotomy group was  $125.0 \pm 71.7$  minutes while the VATS group time was only  $76.2 \pm 30.7$  minutes. Estimated blood loss for the thoracotomy group was  $313.9 \pm 254.0$  milliliters and for the VATS group  $131.6 \pm 77.3$  milliliters. Three of the 30 patients (10.0%) required prolonged ventilator support (>24 hours). Morbidity included one diaphragmatic laceration in the VATS group and one thoracic duct laceration in the thoracotomy group. Two VATS procedures (6.7%) required conversion to open thoracotomy to facilitate thorough decortication.

**DISCUSSION**

The increasing utility of VATS techniques has been recognized by various investigators in the treatment of pleural effusions, hydrothorax, bullous and diffuse emphysema, evaluation of pleural and lung masses and resection

of mediastinal tumors. In addition to providing excellent intrathoracic exposure, VATS has the advantage of incurring less tissue disruption than open thoracotomy. These factors have made it an attractive alternative for investigation as a means of treatment for empyema thoracis.

In their retrospective series of 64 cases of loculated postpneumonic empyemas, Mackinlay et al<sup>1</sup> compared formal thoracotomy and thoracoscopic techniques of treatment. Mean postoperative length of medical management (11.5 vs 17 days) and chest tube removal (4.3 vs 6.1 days) was significantly shorter in the VATS group. In contrast to our findings, their operative time for both approaches was roughly equivalent. They reported a 10% conversion rate from VATS to open thoracotomy that approximates our data (6.7% in our study). Striffeler<sup>5</sup> et al attribute their 28% conversion rate from VATS to an open procedure in the treatment of fibrinopurulent empyema to advanced stage disease.

The most frequently isolated microorganisms from adult pleural empyema cavity fluid cultures are *Staphylococcus aureus* or *Streptococcus pneumoniae*.<sup>6</sup> Current treatment algorithms with early intensive antibiotic therapy frequently sterilize but do not obliterate empyema cavities. Thus, most series of VATS pleural debridement report positive pleural culture results in less than 40% of patients.

Wait et al<sup>7</sup> and his group from Parkland Memorial Hospital examined pleural drainage and fibrinolytic therapy versus VATS in the treatment of empyema thoracis. Primary success rate in the VATS group was 91%, while drainage and fibrinolytics were only primarily successful in less than one-half of cases. Duration of chest tube drainage post-treatment was 5.8 days in the VATS group (equivalent to our findings) versus 9.8 days in the drainage/fibrinolytic group. The total number of hospital days in their VATS group was significantly less than with drainage/fibrinolysis (8.7 vs 12.8 days).

More recently, Lawrence et al<sup>8</sup> examined 44 patients at their institution who, over a three-year period, presented with empyema thoracis. Thirty of the 42 eligible patients were treated successfully with VATS techniques; the remaining twelve patients needed second procedures (this constituted their open thoracotomy group) for definitive treatment of their empyema. Thoracostomy tube drainage times of 4.0 days versus 8.5 days for the VATS and open groups, respectively, approximate our

findings. Duration of stay in their open group is significantly longer than in the VATS group (10.3 vs 5.3 days), although the impact on hospital stay duration of patients in the open thoracotomy group having had two procedures can be questioned.

Most authors agree that one of the major hurdles in optimal management of empyema thoracis, be it with formal thoracotomy or VATS techniques, is the delay between diagnosis and treatment. Given the efficacy of modern antibiotic therapy, over half of decortications performed show no growth of bacteria from intraoperative cultures. By the time surgical intervention is undertaken, several weeks have passed, and the exudative stage of the empyema has evolved into a more chronic fibrinous process. Associated comorbidities become more common as the patient's illness is transformed from a potentially limited one to a chronic disease state. Malnutrition, generalized physical deconditioning, prolonged atelectasis with abscess formation, deep venous thrombosis from inactivity and superinfections from chronic antibiotic administration deleteriously affect the hospital course.

In our series of patients, those treated with the VATS technique had a longer overall hospital stay than their formal thoracotomy counterparts (although not statistically significant). This is likely attributable to the referral of cachetic, immunocompromised, ventilator-dependent patients to us for treatment of empyema thoracis. These patients, who would ordinarily be declined for open surgical intervention, were treated successfully by us using VATS techniques. Their coexisting morbidities frequently resulted in prolonged hospital stays long after thoracostomy drainage tubes had been removed.

Video-assisted thoracoscopic surgical technique is a viable alternative to open thoracotomy in the treatment of complex empyema thoracis. All major studies demonstrate that duration of thoracostomy tube drainage is shorter in VATS groups, and most (in the absence of serious comorbidities) have shown a shorter postoperative hospital stay. We would, therefore, recommend VATS as an early therapeutic approach rather than a late salvage treatment for this often-neglected surgical problem.

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