

# Video-Assisted Thoracic Surgery for Fibropurulent Thoracic Empyema: A Bridge to Open Thoracic Surgery

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**Background:** Thoracic empyema remains a serious problem.

**Objective:** We evaluated the feasibility and efficacy of video-assisted thoracic surgery (VATS) for fibropurulent thoracic empyema.

**Patients and Methods:** Twenty-six consecutive patients with thoracic empyema resistant to medical therapy were treated by VATS from 1997 to 2006. The presence of pleural adhesion was not a contraindication. Patients with destroyed lung, bronchopleural fistula, or excessively thickened pleura were excluded.

**Results:** Twenty-two were males and 4 were females with a mean age of 59 years (range 14 to 85). The length of preoperative period was  $39.3 \pm 25.3$  days, and the length of preoperative treatment was  $11.2 \pm 14.3$  days. The operating time was  $127.6 \pm 45.1$  minutes and intraoperative bleeding was  $353.8 \pm 438.4$  g. Postoperative complications were observed in two cases (8.0%). There were no hospital deaths. Twenty-two cases (84.6%) were cured with a postoperative drainage time of  $12.5 \pm 8.2$  days. Four cases required an additional operation. However, the VATS procedure was not required to perform additional thoracoplasty using pedicled chest wall muscles.

**Conclusions:** VATS for fibropurulent thoracic empyema is effective and less invasive, and it may be important as a bridge between minimally invasive and conventional open thoracic surgical management. (*Ann Thorac Cardiovasc Surg* 2009; 15: 368–372)

**Key words:** fibropurulent thoracic empyema, video-assisted thoracic surgery

## Introduction

Thoracic empyema continues to remain a cause of significant morbidity and mortality despite the aggressive use of broad-spectrum antibiotics in the early phase of the disease.<sup>1-3)</sup> About 20% of parapneumonic effusions progress to thoracic empyema.<sup>4)</sup> There are three stages of thoracic empyema,<sup>5)</sup>

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i.e., the exudative phase (stage I), the fibropurulent phase in which the lung still retains its compliance and capacity to fully reexpand (stage II), and the organized and chronic phase (stage III). Although stage I should be treated with adequate antibiotics and/or early intercostal tube drainage, many cases will progress to stage II or III if the treatment is inadequate. For stage II, several strategies have been reported, including antifibrinolytic enzymatic debridement,<sup>6,7)</sup> tube thoracotomy or thoracotomy,<sup>8,9)</sup> and surgical dissolution of loculation or decortication.<sup>10,11)</sup> Lastly, fenestration of the chest wall and thoracoplasty is imperative for stage III.

The goal of surgical intervention for stage II should be reexpansion of the lung. This surgical treatment has been performed through conventional thoracotomy. However, the recent development of endoscopic techniques of video-assisted thoracic surgery (VATS)<sup>12)</sup> enables us to perform surgical procedures without previously requiring

a large thoracotomy for thoracic empyema.

In this study, we retrospectively analyzed our experience with VATS for the treatment of clinically defined stage II thoracic empyema to assess the efficacy and feasibility of the procedure.

## Patients and Methods

### Patients

From 1997 to 2006, 26 consecutive patients with clinically defined stage II thoracic empyema that was resistant to medical therapy were retrospectively examined in this study. Medical therapy for these cases consisted of antibiotics and closed-chest tube drainage before the operation. Proteolytic agents were not used they were not permitted in Japan. Chest computed tomography (CT) was routinely performed preoperatively to confirm the presence of loculations or pleural thickening. The presence of excessive pleural thickening on chest CT was defined as stage III empyema. The lack of bronchopleural fistula or destroyed lung on chest CT was considered to be an indication for a VATS procedure.

### Procedure

Under general anesthesia with double-lumen endotracheal tube intubation, the affected lung was collapsed and the opposite lung ventilated. The patients were placed in the lateral position with the arm adducted. A standard 10-mm port was placed at an intercostal space around the edge of the empyema cavity, through the wound for the drainage tube, usually the 6th or 7th intercostal space on the middle-to-posterior axillary line, since the loculated space is generally located in the dorsobasal areas of the pleural cavity. We used a 30-degree, 10-mm thoracoscope (OLYMPUS® LTF-V3) or a 5-mm flexible thoracoscope (OLYMPUS® LTF-VP). An additional one or two 10-mm ports were inserted. The exact port position was dependent on the local intrathoracic situation. By means of a thoracoscope port and one or two working ports, the empyema cavity could then be safely approached because of excellent visualization. The complete evacuation of all empyema membranes and fluids and/or decortication was performed by sharp and blunt dissection. Removal of fibrous peel from the lung and diaphragm with standard instruments was the basic procedure. We debrided the whole lung, especially the base, the reexpansion of which seemed important. All fluid was aspirated with regular suction, and fibrous material and dense parietal and visceral peels were removed so that reexpansion of the lung was

possible. The empyema cavity was then irrigated with saline, and the lung was reinflated under thoracoscopic inspection to ensure complete expansion. If the affected lung could not be reexpanded during the operation, conventional fenestration of the chest wall and open drainage would be conducted. Basically, two 24 or 28 Fr. double-lumen chest tubes were inserted in the apical and basal areas of the pleural cavity through the port wounds.

Follow-up consisted of a chest X-ray and/or a chest CT in addition to a clinical investigation. Besides the radiographic findings, if the patients' symptoms, including fever or chest pain or laboratory data such as leucocyte count and/or C-related protein level, had not improved, the empyema was considered to have not been cured by the operation. Preoperative bacteriology, duration of chest tube drainage, duration of hospital stays, postoperative course, and postoperative complications were recorded.

### Measurements

The duration of the preoperative period was defined as the interval between the date of the onset of symptoms and the date of the operation. The duration of preoperative treatment was defined as the interval between the date of the initiation of medical treatment, including the administration of antibiotics or chest tube drainage and the date of the operation. The postoperative drainage time was defined as the interval between the first postoperative day and the day drainage tubes were removed. The postoperative length of hospitalization was defined as the interval between the date of surgery and the date of hospital discharge.

### Statistical analysis

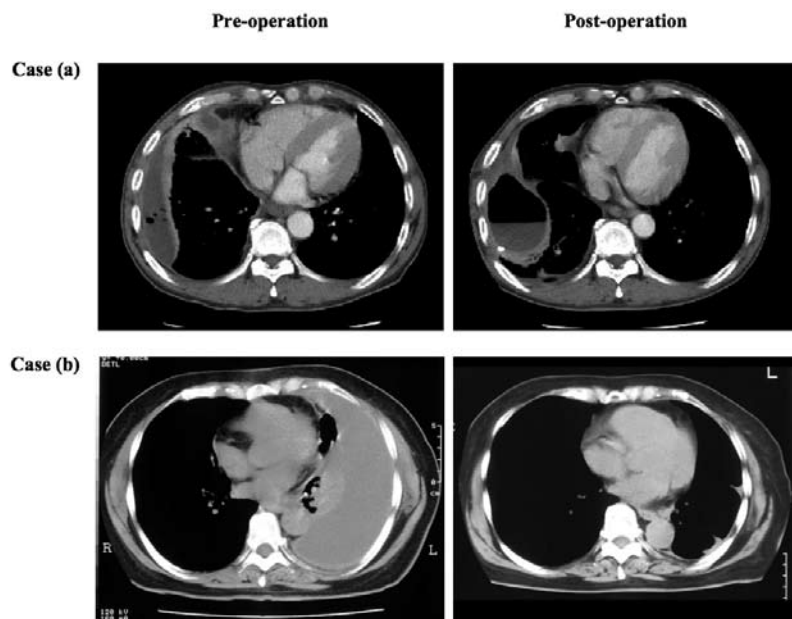
Continuous variables were assessed with the 2-sided Student's *t*-test. A *p* value of less than 0.05 was considered significant. The difference in The Eastern Cooperative Oncology Group Performance Status (ECOG PS) was assessed by Fisher's exact test (JMP 6.0.3., SAS Institute Inc., Cary, NC, USA). The data in this retrospective study were expressed as mean  $\pm$  standard deviation.

## Results

The subjects consisted of 22 males and 4 females with a mean age of 60 years (range, 14 to 85). The preoperative ECOG PS<sup>(13)</sup> was 0 in 2 patients, 1 in 21, and 3 or 4 in 3. Comorbidity was found in 17 of 26 patients (65.4%) (Table 1). Preoperative pleural fluid culture was positive in 16 of 26 patients (61.5%) (8 gram-positive cocci, 2 gram-negative cocci, 3 gram-negative rod, 2 fungi, and 1 mycobacterium).

**Table 1. Patient characteristics**

Number	26
Age (years)	60 (14–85)
Male/female	22/4
PS 0/1–2/3–4	2/21/3
Length of preoperative period (days)	39.3 ± 25.3
Length of preoperative treatment (days)	11.2 ± 14.3
Comorbidity	
Cardiac disease	5
Metabolic disease	3
Central nerve disorder	2
Physiatrics disorder	2
Renal dysfunction	2
Collagen disease	1
Postthoracic radiation	1
Intrabronchial benign polyp	1
None	9
Cause of empyema	
Pneumonia	12
Postpulmonary resection	2
Pneumothorax	1
Postesophagectomy	1
Chest trauma	1
Unknown	9

**Fig. 1.** Preoperative and postoperative chest computed tomography in a case of thoracic empyema.

**Case (a):** a patient in whom the VATS procedure was not effective. The lung is also compressed (left) and not reexpanded (right). Note that there is no significant difference in the thickness of visceral or parietal pleura.

**Case (b):** a patient who was successfully treated with video-assisted thoracoscopic surgery. The lung is covered with thickened pleura and is restricted before the operation (left), and it reexpands after the VATS procedure (right).

The length of preoperative period (LPP) was  $40.6 \pm 27.1$  days, and the length of preoperative treatment (LPT) was  $11.3 \pm 15.3$  days. The operating time was  $123.2 \pm 42.3$  minutes, and intraoperative bleeding was  $372.0 \pm 466.0$  g. Postoperative complications were observed in two cases, including respiratory failure and pneumonia, both of which were corrected by adequate treatment. There were no

hospital deaths. Twenty-two cases (84.6%) were successfully cured (Fig. 1a) with a drainage time of  $12.5 \pm 8.2$  days.

In 4 cases, the lung failed to reexpand by the VATS procedure (Fig. 1b). The characteristics of the 22 patients who successfully recovered (group 1) and the 4 in which the VATS procedure failed (group 2) are listed in Table 2. No significant difference was noted between groups with

**Table 2. Comparison of patients in whom the VATS procedure was successful (group 1) to those in whom it failed (group 2)**

	Group 1	Group 2	<i>p</i>
Number of patients	22	4	
Age (years)	59 (14–85)	61 (54–71)	0.85
ECOG PS 0/1/2–4	2/17/3	0/4/0	0.65
LPP (days)	40.6 ± 27.1	32.0 ± 9.9	0.54
LPT (days)	11.3 ± 15.3	11.0 ± 8.1	0.97
Operative time (minutes)	123.2 ± 42.3	132.0 ± 64.3	0.73
Amount of operative bleeding (grams)	372.0 + 466.0	142.5 + 92.2	0.34

LPP, length of preoperative period; LPT, length of preoperative treatment.

respect to age or ECOG PS. The LPP was 40.6 ± 27.1 days for group 1 and 32.0 ± 9.9 days for group 2, and the LPT was 11.3 ± 15.3 days for group 1 and 11.0 ± 8.1 days for group 2, also with no significant difference ( $p = 0.54$  and  $0.97$ , respectively). There was also no significant difference between the two groups with regard to operative time ( $p = 0.73$ ) or amount of intraoperative bleeding ( $p = 0.34$ ). None of the 22 patients successfully treated by VATS found recurrence of empyema in their follow-up period of 12.9 ± 19.9 months. One patient died as a result of liver cirrhosis 46.2 months after operation.

All 4 patients whom the VATS procedure failed required thoracoplasty using pedicled latissimus dorsi muscle and/or serratus anterior muscle. The findings of preoperative chest CT could not discriminate a difference in the thickness of visceral or parietal pleura considered to be the evident stage III thoracic empyema.

## Comment

Early recognition and aggressive treatment are needed to prevent chronic thoracic empyema. Surgical intervention is required if the lung does not expand despite prompt treatment with antibiotics and/or chest tube drainage.

VATS has become widely used for several types of thoracic surgery since the 1990s.<sup>12)</sup> Although many retrospective findings have suggested that VATS is useful for fibropurulent (stage II) thoracic empyema, an evidence-based guideline assumes its clinical benefit as level C (historically controlled series and case series)<sup>14)</sup> because there are a few prospective randomized control studies.<sup>15–17)</sup> In our experience, however, VATS provides an excellent surgical view and operability for a complicated empyema cavity, thus making it possible to perform a sufficient evacuation of all empyema membranes and fluids and the removal of fibrous peel in the same way as in open surgery.

In this study, 19 of 26 cases (82.6%) were successfully cured with VATS, and this result is comparable to previously reported data.<sup>2,18–22)</sup> The duration of chest drainage was 13.2 ± 8.3 days in the 19 successful cases, and there was no irreversible morbidity.

Four cases required another operation, since none of them could have the lung sufficiently reexpanded by the VATS procedure. Clinical manifestation, such as the duration of the preoperative period or chest CT, failed to determine these four cases as potentially stage III thoracic empyema preoperatively. We recognized that there are several limitations to our retrospective study. The cohort may be biased by patient selection and the small number examined. However, the VATS procedure using two or three ports enabled us to preserve chest wall muscles, and this made it possible to use these muscles for future thoracoplasty, the latissimus dorsi muscle and/or serratus anterior muscle, if required.

In conclusion, our experience suggests that VATS is effective and safe for the treatment of fibropurulent thoracic empyema. For thoracic empyema, VATS also acts as a bridge between minimally invasive and conventional open thoracic management, such as chest wall fenestration or thoracoplasty.

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