

# Video-Thoracoscopic and Open Surgical Management of Thoracic Empyema

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## ABSTRACT

**Background:** Thoracic empyema is a severe complication of pleural infection that is still an important clinical challenge even today due to the advances made in imaging and antibiotic therapy. Surgical intervention becomes mandatory when conservative measures fail.

**Objective:** To compare the outcomes of video-thoracoscopic and open surgical management of empyema in different stages.

**Methodology:** A retrospective observational study was conducted at Liaquat National hospital, Karachi, from January 2020 to December 2022. The study included a total of 110 patients who were diagnosed with thoracic empyema and were managed surgically. Patients were stratified into VATS (n = 60) and thoracotomy (n = 50) groups according to the stage of disease and clinical assessment. Data collected included demographics, disease characteristics, operative details, postoperative complications, hospital stay, and long-term outcomes.

**Results:** In comparison to the thoracotomy group, patients subjected to VATS exhibited statistically significant shorter symptom duration, less operative time (85min vs. 130 min), less intraoperative blood loss (150 ml vs. 300 ml), reduced ICU requirement (6.7% vs. 30%), and shorter hospital stay (6.2 vs. 10.5 days). Recovery of lung function and recurrence rate were comparable in both groups.

**Conclusion:** VATS is a less invasive and effective treatment option for early-stage thoracic empyema, thus leading to favorable perioperative and recovery outcomes. Nevertheless, open thoracotomy remains the standard approach for Stage III or complex empyema. Accurate disease staging and timely surgical intervention are essential for guiding optimal treatment and enhancing patient outcomes.

**Keywords:** Video-Assisted Thoracoscopic Surgery (VATS); Open Thoracotomy; Lung Decortication; Pleural Infection

## Introduction

**E**mpyema thoracis results in pus accumulation in the pleural space, between the lungs and the chest wall.<sup>1</sup> In a healthy individual, the cavity would contain minimal lubricating fluid; however, when infected, it is filled with thick, purulent fluid that impairs respiration and sometimes sets complications into motion. Mostly, empyema in the thorax arises as complications of pneumonia whose course of medication has either not been completed or when an exaggerated immune response results in excess amounts of inflammatory fluid being deposited in the pleural cavity.<sup>2</sup> Other common causes of empyema are trauma to the chest, surgery of the thorax, rupture of the oesophagus, or infection spread from adjacent areas such as the neck (as in mediastinitis).<sup>3</sup> The disease passes through three stages: early exudative stage (Stage I), with thin, free-flowing fluid; fibrinopurulent stage (Stage II), in which pus forms and loculations develop; and chronic organizing stage (Stage III), during which fibrous tissue traps the lung, preventing it from expanding.<sup>4</sup> Without timely treatment, empyema can lead to respiratory failure, sepsis, or death. Thus, early detection and appropriate management, including antibiotics, drainage, and often surgery, are vital in improving the outcome.

It is fundamental to accurately identify the stage of empyema before deciding on the correct treatment option. To determine how far disease has progressed and whether a patient will benefit from less invasive surgery or require more extensive operation, clinical evaluation, laboratory tests, and, most importantly, chest computed tomography (CT) are essential. Video-Assisted Thoracoscopic Surgery (VATS) is a minimally invasive surgical procedure utilized for diagnosing and treating various conditions in the chest, including thoracic empyema.<sup>5</sup> This technique involves making small openings in the patient's chest wall, and the doctors will then insert tiny cameras, which are called thoroscopes, along with the special surgical instruments, through the small openings into the pleural cavity.<sup>6</sup> The images viewed through that procedure are shown on a video monitor connected to the thoracoscope, so a surgeon can work inside the chest without requiring a large incision. VATS is very important in the fibrinopurulent stage of empyema, where thorough drainage of pus, removal of infected tissue, and breakdown of loculations obstructing lung expansion occur. Compared to conventional open thoracotomy, it is shown that post-operative pain is reduced, hospital stays are shortened, recoveries are faster, and the number of complications is reduced. The effect of VATS depends, however, on the degree of disease involved as it is not indicated for late-stage empyema, incased in the lung by very dense adhesions and fibrous tissue. Where this is the case, it may also have to be converted to an open procedure for complete

treatment. However, it is a safe and effective method for treating thoracic empyema under the right conditions.

On the other hand, open surgical management of thoracic empyema, usually done through the surgical approach called thoracotomy, remains the oldest and most definitive method in treating advanced or complicated empyema.<sup>7</sup> In this technique, a large incision in the chest wall is made to directly gain access to the pleural cavity. That allows the surgeon to evacuate thick pus, infected tissue, and the fibrous peel sheathing the lung in lung decortication. Lung decortication is especially necessary in the organizing (stage III) phase of empyema, since other less-invasive methods, such as VATS, have become ineffective due to dense adhesions and entrapped lung tissue.<sup>8</sup> Open approach allows better visualization and access to the affected areas, making it the first choice when the infection has spread or when earlier attempts at drainage have failed.<sup>9</sup> Thoracotomy, though more invasive and requiring a longer recovery time, is incredibly successful in restoring lung function and controlling infection when performed early in patients with severely affected disease.<sup>10</sup> It remains the gold standard for late empyema or empyema in complex settings like with mediastinitis, trauma, or post-operative complications.

This study has been designed to review and compare the results of VATS and thoracotomy in a large group of patients with thoracic empyema. The study focused on the outcome of patients treated over six years to gain an insight into which method of surgical intervention has a better result at different stages of the disease and to stress the fact that surgery is of high importance, especially if performed early enough in the course of the disease. It also aims to understand all possible risk factors for complications and survival outcomes, which will contribute to charting future management options to optimize patient care.

## Objective

To compare the outcomes of video-thoracoscopic and open surgical management empyema in different stages among patients with thoracic empyema.

## Methodology

The observational study assessed the effectiveness and safety of surgical interventions in patients with thoracic empyema from January 2020 to December 2022 at Liaquat National hospital, Karachi. In this study, the patients who had undergone surgery were reviewed as part of the scheme for management of pleural empyema. The study concentrated on two groups of patients who had undergone surgical treatment: one group had a minimally invasive technique, such as video-assisted thoracoscopic surgery (VATS), and the other had an open thoracotomy with or without decortication.

The information of patients included in the analysis had been admitted with clinical signs of pleural infection, including fever, chest pain, cough, breathlessness, and radiological evidence of pleural effusion. Diagnosis was a combination of thoracic imaging, microbiological culture, and pleural fluid analysis. Low pleural fluid pH, high lactate dehydrogenase, and presence of organisms or pus were the laboratory criteria used to confirm the infectious nature of the effusion.

All participants were classified according to the progression of their illness into early or late empyema. This directed the choice of surgery. Patients during the primary phase, when fluid was present without much fibrosis or lung entrapment, were considered for VATS. Those advanced stages were directed toward open thoracotomy, where fibrous tissue would have encased the lung or where imaging revealed multiple loculated collections. The surgical decision is taken not just based on images but according to the patient's clinical stability and duration of symptoms, along with initial conservative measures such as antibiotics and chest tube drainage. Those patients not doing better or showing radiological deterioration would be evaluated for operative management.

The data collected included clinical information such as days of symptoms before surgery, number of days of hospitalization, complication status, microbiology of

pleural fluid, need for re-intervention, and 30-day mortality. Long-term follow-ups were done in outpatient visits and by telephone reviews for lung function recovery and disease recurrence. This extensive compilation provides a real-life clinical comparison of both surgical techniques.

All data were entered into SPSS for further analysis. A comparison of both groups was recorded using the t-test, chi-square test, and p-value 0.05 as significant points for association.

Ethical certificate (IRB-LNC10/01/21) was granted by the ethical board of Liaquat National hospital, Karachi, for conducting this study.

## Results

This study was conducted at the Department of Pulmonology, Liaquat National hospital, Karachi, from 2017 to 2022, and 110 empyema thoracic patients were included. For study purposes, the total 110 participants were divided into two groups, i.e. the VATS group, which included 60 patients, and the Thoracotomy group, which had 50 patients. Male patients were higher in numbers in both groups. In VATS groups, this number was 48 (80.0%), and in the thoracotomy group, the number was 39 (78.0%) (Figure 1).

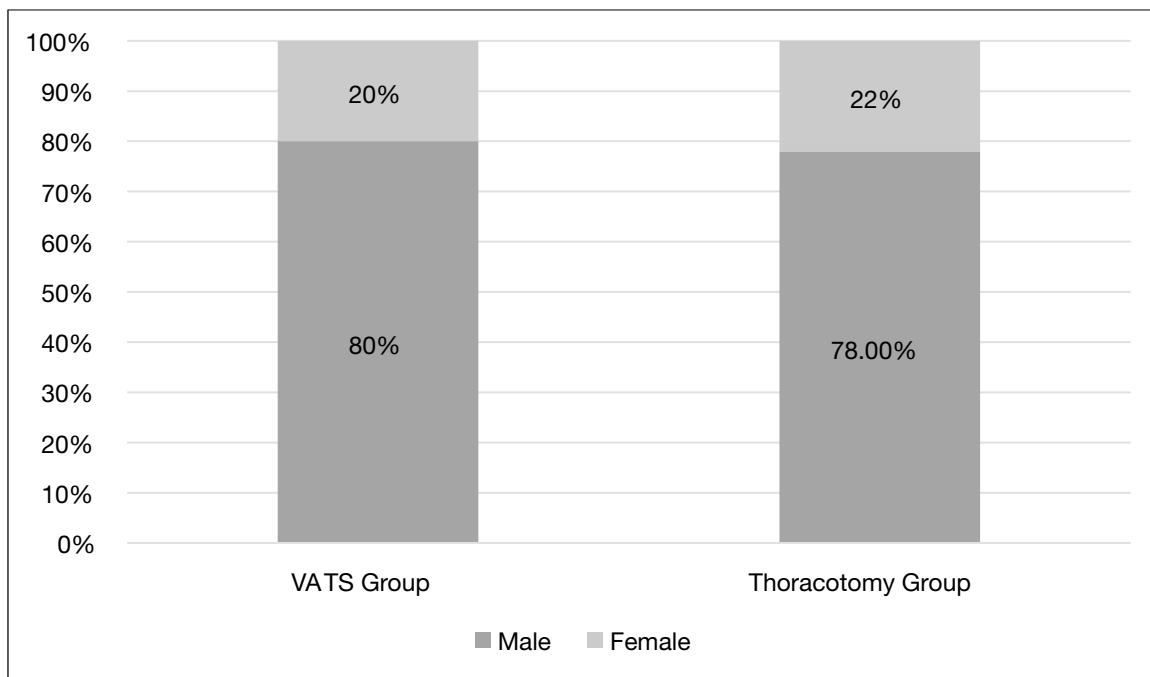


Figure 1. Gender distribution of participants

Of the patients, the thoracotomy group had a longer course of symptoms with a more severe symptomatology ( $16.7 \pm 4.1$ ), particularly breathlessness (88.0%), and were

more likely to have Stage III empyema and comorbidities. The VATS group mostly consisted of patients with an earlier stage of disease and a milder clinical presentation

(Table 1).

Results showed that in comparison with the Thoracotomy group, the VATS group showed significantly less operative time ( $85 \pm 20$ ), lesser blood loss ( $150 \pm 50$ ), and shorter duration of stay in the hospital ( $6.2 \pm 2.1$ ). Also, there is a lower frequency of ICU admission in the VATS group. There was a conversion to thoracotomy in 8.3% of VATS cases (Table 2).

The complications encountered in the VATS group were fewer, such as a lower overall wound infection rate, air leak, and reoperation, although some of these differences were not statistically significant. Notably, the lack of death in the VATS group during the study was compared with 4% of subjects dying within 30 days in the thoracotomy group (Table 3).

Both groups exhibited high recovery percentages in lung functioning at 6 months, with the percentages being even greater in the VATS group. Recurrence of empyema was low in both groups, and the mean follow-up duration was comparable, with no statistically significant variation

observed (Table 4).

## Discussion

This study was conducted to thoroughly compare Video-Assisted Thoracoscopic Surgery (VATS) and open thoracotomy in thoracic empyema management, especially focusing on patients with Stage II and Stage III disease. The results show that VATS has many advantages over thoracotomy in terms of operative convenience, postoperative recovery, and fewer complications. Patients had shorter operative times with VATS ( $85 \pm 20$  minutes vs.  $130 \pm 25$  minutes), lesser intraoperative blood loss ( $150 \pm 50$  ml vs.  $300 \pm 80$  ml), and shorter hospital stays ( $6.2 \pm 2.1$  days vs.  $10.5 \pm 3.4$  days). However, due to the chronic nature of the diseases typical of patients with thoracic empyema, open thoracotomy has remained a valid alternative, and in some cases, an outright advantage over VATS, especially in advanced Stage III. A great advantage of thoracotomy

Table 1. Baseline Demographics and Clinical Presentation

Parameter	VATS Group (n = 60)	Thoracotomy Group (n = 50)
Mean Age (years $\pm$ SD)	$40.6 \pm 12.4$	$44.3 \pm 13.2$
Mean Duration of Symptoms (days $\pm$ SD)	$9.2 \pm 3.8$	$16.7 \pm 4.1$
Fever at Admission	50 patients (83.3%)	46 patients (92.0%)
Chest Pain at Admission	45 patients (75.0%)	43 patients (86.0%)
Breathlessness	40 patients (66.7%)	44 patients (88.0%)
Stage of empyema (II/III)	100% patients in stage II	75% patients in stage III, 25% patients in stage II
Comorbidities (e.g., DM, HTN, TB)	18 patients (30.0%)	20 patients (40.0%)

is the ability to gain fine access to the pleural cavity and completely evacuate the thick pus, remove fibrous tissue, and decorticate the lung completely when dense adhesions have trapped the lung. Conversely, thoracotomy allows recovery in cases where VATS has possibly failed on account of chronicity. In many cases, it will be appropriate to remove all evidence of any infection, often as the ultimate treatment for complicated or intractable empyema, in conjunction with conditions such as mediastinitis or post-traumatic sequelae.

These results align with previous studies, including those by Potaris et al. (2007)<sup>11</sup>, highlighting that VATS debridement resulted in minimal morbidity and zero deaths in patients suffering from fibrinopurulent empye-

ma. The only option effective for patients experiencing organized empyema is through lung decortication using thoracotomy, which has a high mortality associated with it. It was reported in a study by Galetta et al. (2018)<sup>12</sup> that video-assisted thoracoscopic surgery (VATS) provides a minimally invasive management for postpneumectomy empyema (PPE) - even in patients having and not having a small bronchopleural fistula (BPF). Thoracoscopic debridement provides direct visualization and thorough cleaning of infected postpneumectomy spaces from which infection can be controlled with less surgical trauma. This technique shortens the time to recovery, reduces the duration of hospitalization, and prevents the related illnesses associated with open intervention,

Table 2. Operative and hospital data of participants

Variable	VATS Group (n = 60)	Thoracotomy Group (n = 50)	p-value
Mean operative time (minutes)	85 ± 20	130 ± 25	<0.001
Mean blood loss (ml)	150 ± 50	300 ± 80	<0.001
Conversion to thoracotomy (%)	5 (8.3%)	—	—
Mean hospital stay (days)	6.2 ± 2.1	10.5 ± 3.4	<0.001
ICU stay required (%)	4 (6.7%)	15 (30%)	0.002

making it quite effective and safe for treating PPE in appropriately selected patients.

A study conducted by Hajjar et al. (2016)<sup>13</sup> reported that VATS manages fibrinopurulent, organized pyogenic pleural empyema with minimum postoperative pain, a shorter stay, and fewer postoperative complications. VATS can be a very effective first option for Stage II pleural empyema patients who need surgery. It can also be used for Stage III pleural empyema for most patients.

Hossain et al. (2022)<sup>14</sup> emphasized that empyema thoracis, complex effusion, and hemothorax are treated with VATS decortications for a better outcome than open decortications. Patients subjected to VATS have fewer postoperative complications. VATS debridement and decortication are safe and effective in managing empyema thoracis. Shrestha et al (2013)<sup>15</sup> also reported that video thoracoscopic procedure is an option for treating empyema thoracis surgically. The success rates can be higher in earlier stages of the disease. It was reported in a study by Scarci et al. (2015)<sup>16</sup> that VATS has led to faster recovery, shorter hospitalization, and fewer complications in Stage II/III empyema, providing an outstanding alternative to open thoracotomy in selected patients.

Loculated empyemas consist of thick fibrin structures

that prevent effective drainage by chest tubes alone. Direct visualization and mechanical excision of pus and fibrin septations can be achieved through VATS, which results in faster resolution, quicker recovery from the procedure, and shorter hospitalization compared with conservative drainage using a chest tube, and this concept was also supported by a study conducted by Coote and Kay (2005).<sup>17</sup> A study conducted by Carey et al. (1998)<sup>18</sup> reported that the stage of the disease determines the treatment of an empyema. In advanced stages (stage II and stage III), where thick pus and fibrous tissue entrapped the lung, open decortication followed by an early drain removal of the chest wall has been the most efficacious approach. This approach offers a rapid resolution of symptoms with early hospitalization, discharge, and complete disease resolution. In earlier stages, such as the fibrinopurulent phase (stage II), less invasive techniques like fibrinolytics or thoracoscopic adhesiolysis may be considered. However, even in ideal cases, these would not allow for a faster recovery or lower risk than the open decortication procedure when indicated.

The evidence supports the VATS use as the first-line surgical approach to Stage II empyema, as it is favored for minimal invasiveness and better perioperative results. On

Table 3. Postoperative Outcomes and Complications of study cases

Outcome/Complication	VATS Group (n = 60)	Thoracotomy Group (n = 50)	p-value
Wound infection	2 (3.3%)	6 (12.0%)	0.08
Persistent air leak > 5 days	3 (5.0%)	5 (10.0%)	0.31
Residual empyema on imaging	2 (3.3%)	3 (6.0%)	0.46
Reoperation required	1 (1.7%)	4 (8.0%)	0.09
30-day mortality	0 (0%)	2 (4.0%)	0.13

Table 4. Follow-up outcomes of study cases

Variable	VATS Group (n = 60)	Thoracotomy Group (n = 50)	p-value
Lung function recovery (normal at 6 months)	55 (91.6%)	43 (86.0%)	0.10
Recurrence of empyema (%)	1 (1.7%)	3 (6.0%)	0.43
Mean follow-up duration (months)	10.3 ± 3.1	11.1 ± 2.8	0.19

the contrary, open thoracotomy remains the standard for severe cases in Stage III with extensive fibrous adhesions. According to clinical and radiological assessment, timely surgical intervention remains paramount in ensuring good outcomes. The article reports an urgent need to encourage the use of VATS in suitable cases and calls for further work, such as randomized trials, to improve surgical decision-making in thoracic empyema.

## Conclusion

This study highlights the importance of timing surgical intervention in thoracic empyema. Video-Assisted Thoracoscopic Surgery (VATS) is safe, less invasive, and most effective in patients with Stage II disease, with shorter procedure time, reduced blood loss, lower incidence of complications, and faster recovery. However, open thoracotomy with decortication is the final answer for advanced Stage III empyema, particularly when there are dense fibrous encasements and pulmonary entrapment. Evidence strongly favours early surgical intervention based on clinical-radiological assessment, with VATS being the first choice for most cases undergoing surgery.

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