



Research article

Factors involved in the conversion from video-assisted thoracoscopic surgery decortication to open thoracotomy in non-complicated, non-MDR/XDR stage III tuberculous empyema patients: A retrospective intention-to-treat study

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ABSTRACT

Background: This retrospective intention-to-treat study aims to identify risk factors associated with intraoperative conversion from Video-Assisted Thoracoscopic Surgery (VATS) Decortication to open thoracotomy in patients with Stage III Tuberculous Empyema, specifically focusing on non-Multi-Drug Resistant (MDR)/Extensively Drug-Resistant (XDR) cases.

Methods: The study included 122 patients with non-MDR/XDR tuberculous empyema who were initially scheduled for VATS decortication. Patients were divided into two groups: the Thoracoscopy group (n = 64), who successfully underwent VATS decortication, and the Conversion group (n = 58), who required intraoperative conversion to open thoracotomy. Complex cases were excluded from the study. The analysis focused solely on factors leading to conversion, rather than overall treatment outcomes.

Results: A notable difference was observed in the rate of regular preoperative glucocorticoid utilization between the two cohorts, with the Conversion group exhibiting a lower percentage (46.5 %) in comparison to the Thoracoscopy group (75.0 %). Furthermore, the Thoracoscopy group displayed a significantly reduced frequency of ipsilateral lung abnormalities prior to the surgery (37.5 %), as opposed to that of the Conversion group (65.5 %). Multivariate logistic regression analysis revealed that the regular preoperative glucocorticoid use (odds ratio (OR) = 3.444, 95 % confidence interval (CI): 1.602–7.407) and pre-existing pulmonary lesions (OR = 0.31, 95%CI: 0.150–0.663) were potential influential factors.

Conclusion: Inconsistent preoperative glucocorticoid administration and ipsilateral lung lesions were identified as exacerbating factors leading to the complexity of VATS decortication by causing intraoperative pulmonary tissue contusion or hemorrhage, thus hindering the successful completion of VATS decortication and necessitating a conversion to thoracotomy. Awareness of these factors can aid surgeons in making well-informed decisions regarding the preoperative surgical approach.

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1. Background

Pleural tuberculosis is currently the most common form of extrapulmonary tuberculosis, accounting for around one-third of all cases. Tuberculous pleural effusion, the main clinical presentation of pleural tuberculosis infection, has become a major focus of international research [1]. Symptoms can range from chills, fever, and chest discomfort to more severe issues like dyspnea, asphyxia, and even cardiac arrest due to mediastinal shift as the disease progresses [2]. Without timely and adequate treatment in the early stages or if patients do not adhere to treatment, chronic pleural infection can develop. This can lead to pleura-lung adhesion, pleural thickening, and fibrosis, along with the accumulation of caseous material in the pleural cavity due to the immune response. In some cases, spinal tuberculous abscesses may rupture into the pleural cavity, resulting in tuberculous empyema [3,4].

Empyema caused by tuberculosis typically starts with the presence of a viscous, yellow, malodorous fluid. As fibroblasts multiply and scatter, a substantial accumulation of fibrin exudate occurs, converting the parietal pleura into a rigid, fibrous, connective tissue-like formation. This encases the lung, severely inhibiting its expansion. Over time, the encasement process further hinders lung tissue function, with the chest wall experiencing escalating pressure, the intercostal space constricting, and thoracic malformation ensuing. This can lead to thoracic collapse, uneven shoulder alignment, spinal distortion, and scoliosis. In severe instances, there may be notable restrictive respiratory dysfunction and profound cardiopulmonary circulatory insufficiency [5].

In the field of clinical practice, the treatment of stage III tuberculous empyema often involves decortication. This procedure aims to cleanse the thoracic cavity of pus and eliminate the thickened fibrous pleura to alleviate pressure on the lung tissue. The advancement of minimally invasive surgical methods has expanded their utilization in managing tuberculous empyema. In particular, Dr. Zhou Yiming from Shanghai Pulmonary Hospital introduced the use of thoracoscopy for decortication in China. This approach features a significantly smaller surgical opening compared to traditional thoracotomy, which supports the idea of facilitating quicker recovery after surgery [6].

Since 2017, our department has performed VATS decortication on Stage III tuberculous empyema patients, focusing specifically on non-Multi-Drug Resistant (MDR)/Extensively Drug-Resistant (XDR) cases. Despite advancements in this technique, there are instances where single-port thoracoscopy proves unsuitable, necessitating intraoperative conversion to open thoracotomy. However, research on the factors influencing this conversion is limited, particularly in non-complex cases. This retrospective intention-to-treat study aims to address this gap by analyzing a cohort of 122 non-MDR/XDR Stage III tuberculous empyema patients from the Department of Thoracic Surgery at Xi'an Thoracic Hospital. Our objective is to identify the specific factors that lead to intraoperative conversion from VATS decortication to open thoracotomy. Importantly, this study excludes complex cases and focuses solely on conversion factors rather than overall treatment outcomes. The findings could serve as a foundation for preoperative evaluation, potentially helping surgeons determine the most appropriate initial surgical approach for these patients.

2. Study participants and methodology

2.1. Study subject recruitment

This study enrolled patients with Stage III tuberculous empyema who received treatment at the Thoracic Surgery Department of Xi'an Thoracic Hospital from January 2020 to January 2023. A total of 143 patients who underwent surgical procedures were selected after reviewing their medical records and radiology reports. Thirteen patients with drug-resistant tuberculosis, two patients with spinal tuberculosis, and six patients who chose conservative treatment over surgery were excluded based on specific criteria, resulting in a final group of 122 patients. Among them, 64 patients underwent VATS pleural decortication, forming the Thoracoscopy group, while 58 patients were converted to open thoracotomy intraprocedurally, forming the Open Thoracotomy (Conversion group). The study group comprised 59 male and 63 female participants, all aged 18 years and above, with a median age (Q1, Q3) of 49 (42, 59) years. In the thoracoscopy group, the participants were over 18 years old, with a median age (Q1, Q3) of 49 (41, 59) years. Contrastingly, among those who required conversion to thoracotomy, the age range was 28–74 years, with a median age of 52 (43, 57) years. The analysis of the patients' hospital records aimed to identify common risk factors such as gender, age, preoperative steroid use, concurrent pulmonary disease on the affected side, chest wall collapse, pleural calcification, and other relevant parameters. Inclusion and exclusion criteria.

Inclusion criteria: 1. The preoperative diagnosis of tuberculous empyema was validated through the examination of pleural fluid and tissue samples. 2. The preoperative chest CT scans demonstrated signs of encapsulated pleural effusion, fibrous plaque formation, and compression of lung tissue. 3. A rigorous preoperative regimen of anti-tuberculosis treatment, lasting at least two months, was completed with internal medicine (specifically, a 2H-R-E-Z/4H-R regimen), and absence of symptoms of tuberculosis intoxication. 4. The preoperative anesthesiologist's evaluation confirmed the patient's suitability for general anesthesia.

Exclusion criteria: 1. Patients with a diagnosis of drug-resistant tuberculosis. 2. Patients showing lesions extending beyond pleural tissue and those with complicated co-occurring diseases including, but not limited to, bone tuberculosis, intestinal tuberculosis, and tuberculous meningitis. 3. Patients who, despite qualifying for surgical procedures, opted for conservative treatment. 4. Patients who became unreachable or lost contact at any stage during the treatment process.

2.2. Definition and diagnosis

Empyema thoracis, a condition characterized by the accumulation of fluid in the pleural cavity, can be classified into three stages based on the criteria established by the American Thoracic Society. The initial stage, termed the Inflammatory Exudation Stage or

Stage I, is characterized by the presence of clear and thin pleural effusion. This stage typically represents the early phase of the condition. Following this, the second stage, known as the Fibropurulent Stage or Stage II, typically occurs after an infection in the pleural cavity. This results in pleural thickening and the development of cloudy, viscous effusion. The third and final stage, referred to as the Fibrous Plaque Formation Stage or Stage III, involves further thickening of fibrous plaques within the pleural cavity. As these plaques compress healthy lung tissue, patients may experience severe breathing difficulties, especially in advanced cases. Key features of this stage may include narrowed intercostal spaces, collapsed chest walls, and the presence of calcified fibrous plaques. Chest wall collapse definition: when the patient is supine, if a perpendicular line drawn from the midline of the affected clavicle towards the sternum plane measures greater than 1 cm, it suggests a collapsed chest wall. This classification system provides valuable insights into the progression and potential complications associated with Empyema thoracis, allowing for more effective management and treatment strategies (Fig. 1) [7].

Confirmation of chest wall collapse diagnosis can be achieved through chest CT scan. When the patient is lying supine, draw a line perpendicular from the midline of the affected clavicle towards the sternum plane. If the vertical measurement is greater than 1 cm, it suggests a collapsed chest wall. Conversely, fibrous plaque calcification is defined as a calcified region of at least 3 cm along the lung axis within the thickened pleura, as visualized on a CT scan. The term "glucocorticoid usage" refers to individuals who had been following a consistent schedule of taking oral prednisolone tablets (5 mg each, provided by Guangdong Huanan Pharmaceutical group Co., Ltd., batch no. H12020809) prior to surgery. The prescribed dose starts at 25 mg/day and is decreased by 5 mg every five days until the medication is terminated before the operation.

2.3. Research methodology

The examination focused on six main variables: gender, age [grouped as per the guidelines set by the Chinese Ministry of Health for Young Adults (18–44 years); Middle-aged Adults (45–59 years); and Seniors (≥ 60 years)], prior administration of glucocorticoids, presence of pulmonary tuberculosis lesions in lung tissue, collapse of the chest wall, and calcification of fibrous plaques. Only individuals treated by the same surgical group were part of the research.

To guarantee the precision and thoroughness of the data, both the attending physicians and the responsible nurses meticulously gathered the information of the patients, with further verification upon completion. All patients received a standardized initial treatment plan for tuberculous empyema lasting at least six months. The research methodically recorded any negative medication side effects, modifications in therapy plans, and alterations in post-treatment clinical symptoms.

2.4. Surgical operation procedures

1. VATS decortication

After administering general anesthesia and performing double-lumen endotracheal intubation, an ultrasound scan was used to identify the empyema pocket on the affected lung side. A 5 cm cut was created at the cavity's depth to reach the pleural space. By using blunt dissection, the dense fibrous plaque surrounding the area was isolated and extracted. Gauze was placed around the cut for

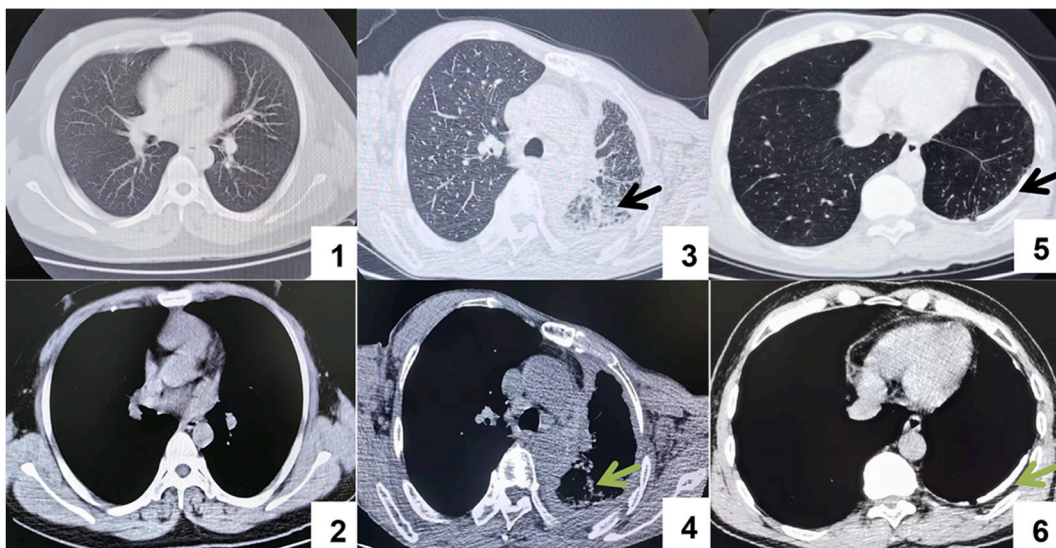


Fig. 1. Depiction of thoracic variations and pathological changes

Images 1–2: Normal thoracic morphology; Images 3–4: Arrows indicating lesions in left lung tissue; Images 5–6: Arrows highlighting calcification in fibrous plaques.

hemostasis, and an incision protector was used before removing the fibrous plaque and entering the empyema pocket.

The subsequent procedure involved utilizing a thoracoscope for extraction of the thickened fibrous plaque. A cross-shaped (+) cut was performed on the exterior of the visceral pleural tissue, establishing a gap between the visceral pleural tissue and the lung tissue surface. Blunt dissection was implemented within this gap through the use of thoracoscopic strippers and scissors for detaching the fibrous plaque and releasing the lung tissue to enable full relaxation. The dissection boundaries ranged from the lower surface of the diaphragm, rising up to the apex of the thoracic cavity and normal lung tissue, spanning from the anterior surface of the pericardium within the mediastinum, advancing as far as 2 cm anterior to the vertebral body.

Following strict measures to control bleeding, the compressed lobe of the lung was reinflated using a ventilator. A comprehensive evaluation of the lung's condition was conducted to detect any potential air leaks, after which the wounds on the surface of the lung were sutured. A thorough examination of the chest cavity was performed to verify that all bleeding had stopped effectively, and to confirm this, two 28F caliber closed drainage tubes were carefully positioned in the intercostal spaces near the surgical site. Finally, the surgical incision was meticulously sealed.

2. Conversion to thoracotomy

The procedure was initiated with a 15 cm surgical incision along the rib line, sometimes necessitating partial rib removal to access the empyema cavity. After draining the abscess contents, both the parietal and visceral pleurae were carefully decorticated to promote re-expansion of the lung. Repair of damaged lung tissue was then carried out once optimal ventilation was achieved by the anesthesiologist. Finally, a drainage tube was placed correctly before the surgical incision was closed.

2.5. Statistical analysis

Data analysis was done with SPSS 20.0 software. The results were presented as [n (%)], and a chi-square (χ^2) test was done for assessment. Both univariate and multivariate logistic regression analyses were used to recognize factors influencing the transition to thoracotomy during VATS pleural decortication operation. A P-value <0.05 was deemed statistically important, indicating a statistical refusal of the null hypothesis.

3. Results

3.1. Univariate analysis

In our analysis, we examined the age, gender, chest wall collapse, and fibrous plaque calcification of the two patient groups and observed no statistically significant variances. Noteworthy was the fact that 75 % (48/64) of patients in the thoracoscopy cohort had consistently utilized glucocorticoids prior to surgery, a significantly higher percentage compared to the 46.5 % (27/58) in the thoracotomy conversion group. Furthermore, the prevalence of patients with pre-existing pulmonary tuberculosis lesions in their lung tissue was markedly elevated in the Conversion group, standing at 65.5 % (38/58), as opposed to only 37.5 % (24/64) in the Thoracoscopy group. Importantly, these discrepancies were confirmed to be statistically significant (Table 1).

Table 1

Univariate analysis of stage III tuberculous empyema patients undergoing VATS fibrous plaque stripping with intraoperative conversion to thoracotomy [n (%)].

| Factor | Thoracoscopy group (64 cases) | Conversion group (58 cases) | χ^2 Value | P Value |
|-------------------------------|-------------------------------|-----------------------------|----------------|---------|
| Gender | | | 1.04 | 0.33 |
| Male | 42 (65.6 %) | 43 (74.1 %) | | |
| Female | 22 (34.4 %) | 15 (25.9 %) | | |
| Age | | | 0.46 | 0.79 |
| Young Adults | 18 (28.1 %) | 15 (25.9 %) | | |
| Middle-aged Adults | 31 (48.4 %) | 32 (55.2 %) | | |
| Seniors | 15 (23.5 %) | 11 (18.9 %) | | |
| Chest wall collapse | | | 0.8 | 0.36 |
| Yes | 29 (45.3 %) | 31 (53.4 %) | | |
| No | 35 (54.7 %) | 27 (46.6 %) | | |
| Fibrous plaque calcification | | | 1.31 | 0.3 |
| Yes | 14 (21.8 %) | 18 (31.1 %) | | |
| No | 50 (78.2 %) | 40 (68.9 %) | | |
| Ipsilateral pulmonary lesions | | | 9.55 | 0.02 |
| Yes | 24 (37.5 %) | 38 (65.5 %) | | |
| No | 40 (62.5 %) | 20 (34.5 %) | | |
| Glucocorticoid use | | | 10.3 | 0.02 |
| Yes | 48 (75.0 %) | 27 (46.5 %) | | |
| No | 16 (25.0 %) | 31 (53.5 %) | | |

3.2. Multivariate logistic analysis

A multivariate logistic regression analysis was carried out with different predictors (refer to [Table 2](#) for variable allocation). The findings indicated that consistent use of glucocorticoids before surgery and the presence of pre-existing pulmonary tuberculosis lesions in the lung tissue were identified as risk factors for transitioning to thoracotomy instead of thoracoscopic surgery ([Table 3](#)).

4. Discussion

Extrapulmonary tuberculosis (TB) cases have been continuously increasing each year, particularly affecting the pleura, spine, and lymph nodes [5,8]. Pleural tuberculosis, which makes up one-third of all extrapulmonary TB cases, is now the most common type. Most patients with pleural TB typically present with pleural effusion as the primary symptom. Due to either inadequate or delayed therapy, some patients experience a shift from tuberculous pleural effusion to tuberculous pleurisy. This advancement also triggers the development of fibrous plaques in the pleural space, resulting in tuberculous empyema. This condition poses significant obstacles for surgical intervention. Traditional surgical techniques require an open thoracotomy to eliminate fibrous plaques in individuals suffering from tuberculous empyema. Nevertheless, video-assisted thoracoscopic surgery (VATS) offers a feasible alternative for these intricate operations [9].

When treating individuals with Stage III tuberculosis empyema, our main strategy involves utilizing VATS guidance to remove fibrous plaque as treatment. However, the inclusion of a one-port thoracoscopic pleural decortication method may present extra hurdles, primarily due to the restricted area for operation caused by substantial pleural thickening and disease-related compression of the intercostal space. Consequently, significant narrowing of the intercostal space and the presence of calcified pleura are often seen as conditions that make thoracoscopic surgery less advisable [10].

Our data support the safety and effectiveness of long, curved, and custom-designed periosteal elevators for fibrous plaque removal using single-port video thoracoscopic techniques, especially in patients with severe narrowing of the intercostal space. On the other hand, previous research indicates that open surgery may be associated with a higher incidence of surgery-related complications, increased trauma, and potential mortality compared to minimally invasive procedures. With the rapid advancement of minimally invasive surgical techniques, thoracoscopy is now recognized as a beneficial adjunctive therapy for empyema, and the single-port thoracoscopic approach is considered the least invasive option [11–13]. However, minimally invasive surgery might not always be the best initial treatment for individuals with extensive lesions, complex pleural conditions, or inadequate responses to anti-TB therapy. Yet, recent advancements in drug-resistant TB diagnosis and treatment may expand surgical eligibility for these patients.

The ongoing debate regarding the utilization of glucocorticoids as additional preoperative medications for stage III tuberculous empyema remains a contentious topic. Glucocorticoids are recognized for their ability to effectively hinder the formation of inflammatory granulation tissue and the growth of connective tissue, which in turn lowers the chance of pleural adhesion and eases the execution of the VATS fibrous plaque removal procedure. Studies carried out by Liu Yugang and colleagues have shown that administering glucocorticoids before surgery can reduce intraoperative bleeding, shorten the duration of the operation, and lower the incidence of bronchopleural fistula [14]. Nevertheless, the sudden discontinuation of glucocorticoids prior to surgery could worsen the condition. We found that two patients did not follow their prescribed medication plans, which exacerbated their conditions (specifically, they had spinal TB), making them ineligible for the study. It was noted in this investigation that 75.0 % (48 out of 64 cases) of patients in the Thoracoscopy group received glucocorticoids before the operation. This percentage is notably higher compared to the 46.5 % (27 out of 58 cases) in the Conversion group. Our findings indicate that consistent preoperative use of glucocorticoids is associated with a higher success rate of VATS pleural decortication. This is likely due to the anti-inflammatory effects of glucocorticoids, which can reduce adhesions and make the surgical procedure easier. However, it's important to note that inconsistent or improper use of glucocorticoids may lead to complications. Based on our findings, we recommend a standardized preoperative glucocorticoid regimen for patients with stage III tuberculous empyema who are candidates for VATS pleural decortication, starting at 25 mg per day and reducing by 5 mg every five days. This approach aims to optimize the benefits of glucocorticoid use while minimizing potential risks. However, this should be implemented cautiously, with close monitoring for potential side effects and contraindications.

When patients exhibited inconsistent glucocorticoid use before surgery, we found severe adhesion between the lung tissue and visceral pleura. This complexity posed challenges in distinguishing between the two, sometimes resulting in lung tissue lacerations. In severe cases, significant lung contusions and postoperative bronchopleural fistulas were seen. Recent research suggests that consistent preoperative glucocorticoid use may not reverse fibrosis in the pleura. Nonetheless, these drugs can reduce adhesion between the

Table 2
Variable assignment for multivariate logistic regression analysis.

| Serial No. | Variable | Assignment |
|------------|-------------------------------|--|
| X1 | Gender | 1 = Male; 0 = Female |
| X2 | Age | 1 = Young Adults; 2 = Middle-aged; 3 = Seniors |
| X3 | Chest wall collapse | 1 = Yes; 0 = No |
| X4 | Fibrous plaque calcification | 1 = Yes; 0 = No |
| X5 | Ipsilateral pulmonary lesions | 1 = Yes; 0 = No |
| X6 | Glucocorticoid use | 1 = Yes; 0 = No |

Table 3

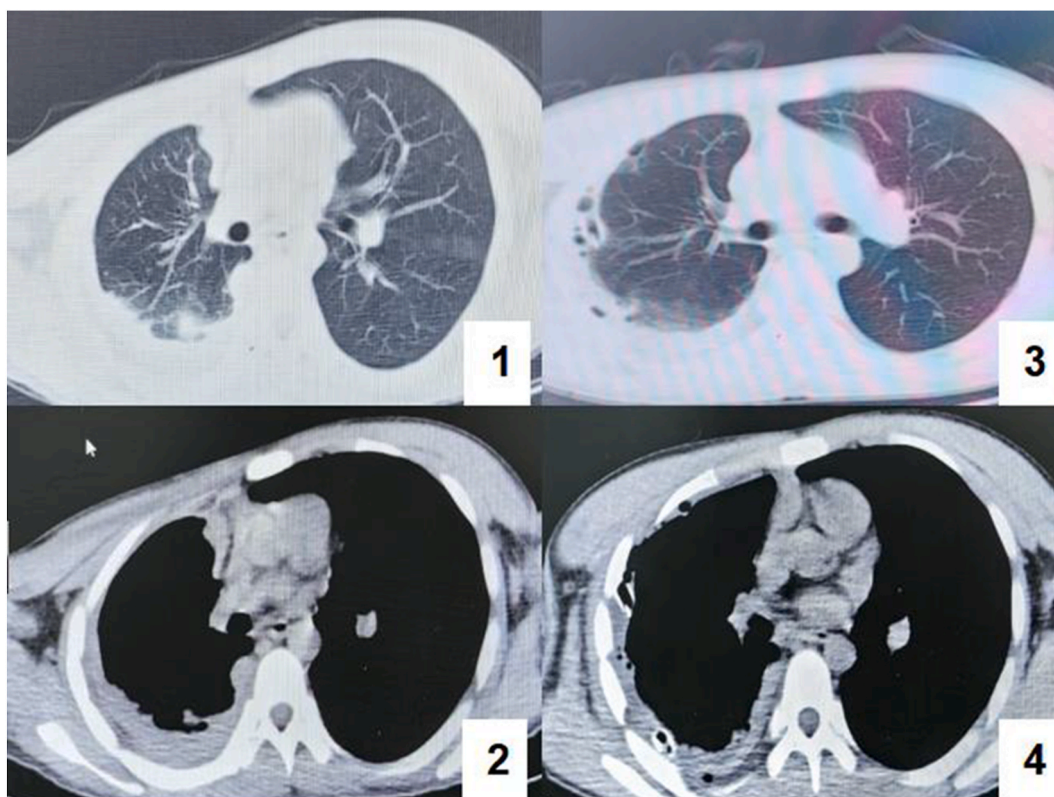
Multivariate logistic regression analysis of patients with stage III tuberculous empyema undergoing intraoperative conversion to thoracotomy.

| Factor | β | S.E. | Wald χ^2 | P | OR | 95 % CI |
|-------------------------------|---------|-------|---------------|------|-------|-------------|
| Ipsilateral pulmonary lesions | 1.356 | 0.432 | 9.870 | 0.02 | 0.316 | 0.150–0.663 |
| Glucocorticoid use | 1.168 | 0.434 | 11.576 | 0.02 | 3.444 | 1.602–7.407 |

visceral pleura and lung tissue, facilitating fibrous plaque removal surgery. Therefore, caution is advised when considering VATS fibrous plaque removal surgery for stage III tuberculous empyema patients who have not used glucocorticoids regularly before surgery.

In contrast to the conventional open-chest pleural decortication techniques, single-port thoracoscopy presents improved visual accessibility to regions normally inaccessible with traditional approaches, leading to enhanced precision in surgical procedures. However, it should be emphasized that the traditional thoracotomy method still retains specific benefits in terms of surgical security and handling. Among the patients in the Thoracoscopy group, 24 individuals, accounting for 37.5 %, exhibited extensive peripheral lung tuberculosis manifestations. Conversely, within the Conversion group, this figure escalated to 38 patients, representing 65.5 %. The variation between the two categories holds statistical importance. Given the strong adhesion of peripheral tuberculosis lesions to the visceral pleura, thoracoscopic procedures present specific challenges. Removing the visceral pleura during thoracoscopy raises the possibility of lung tearing and unintended lung tissue penetration, which can result in severe pulmonary lacerations or harm to the pulmonary arteries and veins. Consequently, meticulous preoperative evaluations play a vital role in guaranteeing the safety of these surgical interventions. Hence, when evaluating patients for VATS pleural stripping, the presence of preoperative ipsilateral pulmonary lesions should be factored in as a potential risk [14].

Previous studies have shown that the constriction of the space between the ribs can result in the collapse of the chest wall and the formation of hardened fibrous deposits, both of which can make VATS for pleural stripping more challenging. Jiang and colleagues [15] suggested that the presence of these calcified fibrous deposits not only prolong the surgery but also increase the risk of excessive bleeding within the chest cavity. Therefore, they recommended switching to thoracotomy procedures to reduce the likelihood of complications during the recovery period [16–18]. Nevertheless, our data showed no significant differences between patient groups regarding the occurrence of chest wall collapse and pleural calcification. These results indicate a lack of substantial association

**Fig. 2. Pre-operative and post-operative chest scan of a male patient.**

Patient: Male, 78 years old; Diagnosis: Tuberculous empyema; Lesion location: Right pleural cavity; Preoperative chest CT (Images 1–2): Thickening of the right pleura and chest wall collapse; Postoperative day 3 chest CT (Images 3–4): Significant improvement in right chest wall collapse compared to preoperative state.

between these ailments and the need for a thoracotomy during VATS-assisted pleural decortication. The skill and methods employed by the surgeon could influence these results. Initially, there were instances of operations being changed to a thoracotomy during surgery due to inadequate surgical skill. However, as the number of surgeries grew, these occurrences decreased significantly, demonstrating a noticeable learning curve phenomenon.

This study also explored how age impacts the transition from VATS pleural decortication to thoracotomy in individuals with stage III tuberculous empyema. There was no notable discrepancy between the two groups across all age categories. Additionally, within the older population, 15 patients received thoracoscopic surgery, surpassing the 11 cases that required thoracotomy. This suggests that using single-port VATS for stage III tuberculous empyema not only facilitated effective lung re-expansion during the operation but also decreased postoperative pain and intercostal nerve damage without elevating the anesthesia peril (Fig. 2). A previous article also reported a successful instance of VATS pleural decortication in an 81-year-old individual who exhibited significant respiratory enhancement post-surgery [19]. Similarly, Liu and co-authors [9] confirmed the feasibility and safety of VATS pleural decortication, revealing comparable outcomes in infection management and lung function recuperation relative to thoracotomy. Moreover, this approach offers low adverse effects and favorable pleural aesthetics.

This study has several limitations that should be addressed in future research. Firstly, it is a retrospective single-center study, which may limit the generalizability of our findings. We did not compare postoperative recovery between VATS and thoracotomy groups, nor did we measure bleeding volumes between converted and planned thoracotomies. These aspects could provide valuable insights into the outcomes of different surgical approaches. Additionally, our study excluded patients with drug-resistant tuberculosis, limiting our understanding of surgical outcomes in this subgroup. Future multi-center, prospective studies should address these limitations and consider comparing postoperative recovery, bleeding volumes, and outcomes in drug-resistant cases. Furthermore, investigating the potential need for thoracoplasty or muscle interposition in more complex cases could provide a more comprehensive understanding of surgical management in tuberculous empyema. Future research should also aim to standardize the definition and measurement of chest wall deformities in this patient population to ensure consistency across studies.

To sum up, our data suggest that consistent preoperative administration of glucocorticoids is associated with a lower likelihood of conversion from VATS pleural decortication to thoracotomy, while the presence of ipsilateral pulmonary abnormalities on the impacted side is associated with a higher likelihood of such conversion. Thus, glucocorticoid usage should be taken into account when deciding on a preoperative surgical plan [20]. However, the conclusion of our study is constrained by a small sample size and narrow inclusion criteria. Future clinical investigations should focus on exploring additional pertinent factors to gain meaningful perspectives.

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Consent for publication

Consent for publication was obtained from the participants.

Ethic statement

This study was approved by Medical Science Research Ethics Sub Committee of Xi'an Chest Hospital(No: S2020-0003). The patients have read and signed the informed consent form to participate.

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CRediT authorship contribution statement

Dangze Sun: Writing – original draft, Resources, Project administration, Data curation, Conceptualization. **Chao Ding:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Liyun Dang:** Software, Funding acquisition, Formal analysis, Data curation. **Xiaotong Yue:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Data curation. **Weitong Wu:** Software, Resources, Project administration, Data curation. **Bei Wang:** Writing – review & editing, Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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