Comparison of VATS and Thoracotomy in The Treatment of Empyema Thoracis In Children: A Retrospective Observational Study

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Abstract

Introduction: The use of minimally invasive surgical techniques, such as VATS, has impacted the management of intrathoracic diseases, including empyema thoracis (ET). While VATS is superior to thoracotomy in various thoracic diseases, no specific intervention has been proven superior for ET, and its superiority in the pediatric population is not well-established. A retrospective study was conducted to compare outcomes between VATS and thoracotomy in managing ET.

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Materials and Methods: This is a retrospective observational study of 80 patients who underwent surgery for empyema thoracis. The patients were divided into two groups: VATS and thoracotomy. The outcomes measured were length of stay, admission days after surgery, need for segmentectomy, wound infection, pneumothorax, retained hemothorax, emphysema, redo surgery, and mortality rate.

Results: There were 42 patients in the thoracotomy group and 38 patients in the VATS group. The two groups did not differ significantly in terms of age, gender, involved side, etiology, and stage of the disease. The length of stay after surgery was slightly longer in the thoracotomy group than the VATS group, but the difference was not statistically significant. The incidence of wound infection, pneumothorax, retained hemothorax, and emphysema was significantly higher in the thoracotomy group than the VATS group. However, there was no significant difference between the two groups in terms of redo surgery and mortality rate.

Conclusion: VATS is associated with fewer complications, including wound infection, pneumothorax, retained hemothorax, and emphysema. Therefore, VATS should be considered as a safe surgical intervention for empyema thoracis.

Keywords

- VATS
- Thoracotomy
- Empyema thoracis
- Minimally invasive surgery
- Wound infection

Introduction

With the introduction of video-assisted thoracoscopic surgery (VATS) and other minimally invasive surgical techniques, the management of intrathoracic diseases has been significantly impacted. Empyema thoracis (ET), a condition characterized by the accumulation of pus and fibrin in the pleural space, is not an exception to this trend.[1] Fortunately, there have been several studies examining the advantages and disadvantages of VATS versus conventional thoracotomy in the treatment of ET. While numerous studies suggest that VATS is superior to thoracotomy in various thoracic diseases in terms of hospitalization, pain reduction, and decreased complications, no specific surgical intervention has been proven to be superior in the management of ET.[2] Moreover, the superiority of VATS over thoracotomy in the pediatric population has not been well-established.

In this retrospective observational study, we intended to analyze our experience in the management of ET with both VATS and thoracotomy, and compare the outcomes together.

Materials and Methods

Study design:

This study is a retrospective observational study that compared two types of surgical interventions for the treatment of pulmonary empyema in pediatric population. The participants were patients who underwent surgical intervention for empyema thoracis in a single center in Iran between January 2017 and December 2023. The patients were divided into two groups based on the type of surgical intervention they received - thoracotomy group and VATS group.

Setting:

All the surgeries were performed by board-certified pediatric surgeons, and the patients received general anesthesia using double-lumen endotracheal tube. In both procedures, the patient was placed in a standard lateral or semi-lateral position. Open thoracotomy was done with a posterolateral incision, which was adjusted by the patient's age and body. On the other hand, VATS often was performed with three incisions, and a 5-mm 30-degree telescope. Postoperatively, two chest tubes were placed in the affected hemithorax.

Plain X-rays were taken in upright position (if possible) at day three of surgery, and the thoracostomy tubes were removed accordingly. Stages of empyema include, simple parapneumonic effusion (stage I), complicated parapneumonic effusion (stage II), and organized pleural empyema (stage III) .[3]

Inclusion criteria

All the children younger than 15 years of age with a diagnosis of ET were included in the study, and only patients who undergone surgical intervention were selected. Also, diagnostic criteria were based on laboratory tests and imaging studies. laboratory criteria included intrapleural glucose less than 40 mg/dL, LDH > 1000 IU/mL, pH < 7.2, a positive gram stain or culture .[4] Only bacterial ETs were entered to the study, and nonbacterial ETs, included mycobacterial empyema, were excluded. Also, patients who were referred from primary centers with a history of previous thoracic surgeries were not included.

Data collection:

Demographics and preoperative information such as age, gender, involved side, etiology, stage of the disease, length of stay, symptoms duration, medical treatment duration, and admission days after surgery were collected from the medical records of the patients. The correlation between surgery type and outcome variables such as need for segmentectomy, wound infection, other complications, redo surgery, and mortality was also recorded by a trained physician.

Statistical analysis: The data were analyzed using descriptive statistics such as mean and standard deviation for continuous variables and percentage for categorical variables. The p-values were calculated using chi-square test, Fisher's exact test, one-way ANOVA, and independent t-test as appropriate. A p-value less than 0.05 was considered statistically significant.

Result

A total of 80 patients were included in the study, with 42 patients in the thoracotomy group and 38 patients in the VATS group. There was no significant difference between the two groups in terms of age, gender, involved side, etiology, and stage of the disease (p>0.05). The length of stay (days) after surgery were slightly longer in the thoracotomy group than the VATS

group (27.0 vs. 22.0, p = 0.078, 19.3 vs. 15.1, p = 15.1, respectively), but the difference was not statistically significant (p>0.05). **(Table 1).**

Table 1:

Variable	Thoracotomy	VATS	Total	p-value
Age (mean)	5.9 ± 4.2	6.5 ± 4.9	5.8 ± 4.5	0.371
Gender (%)				0.982
Male	20 (52.6)	22 (52.4)	42 (52.5)	
Female	18 (47.4)	20 (47.6)	38 (47.5)	
Involved side (%)				0.779
Right	21 (55.3)	23 (54.8)	44 (55)	
Left	15 (39.4)	18 (42.9)	33 (41.3)	
Bilateral	2 (5.3)	1 (2.3)	3 (3.8)	
Etiology (%)				0.505*
Adjacent pneumonia	32 (84.2)	38 (90.5)	70 (87.5)	
Infection after surgery or trauma	6 (15.8)	4 (9.5)	10 (12.5)	
Stage of the disease (%)				0.379
I	1 (2.6)	4 (9.5)	5 (6.3)	
II	21 (53.3)	24 (57.1)	45 (56.3)	
III	16 (42.1)	14 (33.3)	30 (37.5)	
Length of stay (mean)	27.0 ± 16.8	22.0 ± 11.7	24.2 ± 14.2	0.078
Symptoms duration	10.6 ± 6.9	9.0 ± 6.6	9.4 ± 8.6	0.931
Medical treatment duration	7.4 ± 6.3	7.4 ± 6.0	7.4 ± 7.1	0.164
Admission days after surgery	19.3 ± 12.1	15.1 ± 9.6	17.2 ± 11.0	0.233

Outcomes:

Table 2 thoroughly represents the correlation between surgery type and outcome metrics. The need for segmentectomy was similar in both groups (p=0.607). However, the incidence of wound infection was significantly higher in the thoracotomy group than the VATS group (p=0.004). Other complications such as pneumothorax, retained hemothorax, and emphysema were also more common in the thoracotomy group than the VATS group (p=0.048). There was no significant difference between the two groups in terms of redo surgery and mortality rate (p>0.05).

Table 2:

Outcome parameter	Thoracotomy	VATS	p-value
Need for segmentectomy (%)	9 (52.9)	8 (47.1)	0.607
Wound infection (%)	7 (18.4)	0	**0.004**
Other complications* (%)	14 (36.8)	5 (11.9)	**0.048**
Redo surgery (%)	2 (5.3)	4 (9.5)	0.678
Mortality	2 (5.3)	1 (2.4)	0.602

Discussion

The present study aimed to investigate and compare the outcomes of thoracotomy and VATS in the treatment of empyema thoracis (ET) in a pediatric population. The results showed that both surgical techniques were comparable in terms of demographics and preoperative information, including age, gender, involved side, etiology, and stage of the disease. Additionally, the length of stay (days) after surgery were slightly longer in the thoracotomy group, although not statistically significant. However, the incidence of wound infection and other complications such as pneumothorax, retained hemothorax, and emphysema were significantly higher in the thoracotomy group compared to the VATS group. These

findings suggest that VATS may be a safer and less invasive surgical intervention for pediatric patients with ET.

Empyema thoracis (ET) is a condition where pus and fibrin accumulate inside the thoracic cavity. It is estimated that 0.6% of pneumonias in children, may progress to ET, and there is tendency to involve right lung more than the left side. However, this number may vary based on the level of development of countries.[5] Traditionally, several bacterial and mycobacterial infections may develop ET, but the most common cause of ET is complicated parapneumonic effusions due to unresolved adjacent lung pneumonias.[6] Children with prolonged upper respiratory symptoms along with fever are likely to develop ET. Clinically, imaging studies should be performed to distinguish between simple pneumonia and ET. Additionally, in a highly suspicious case thoracentesis can be helpful. A positive diagnostic criterion based on the level of glucose, LDH, and pH, almost always mandates drainage along with antibiotic therapy. Although chest drainage often drains the pus successfully and the majority of patients don't require more invasive treatments, in some cases surgical intervention is necessary.[7] Retained pyothorax, unexpanded lungs, fever, and continuous respiratory symptoms after medical treatment may indicate the need for surgery. Imaging studies such as computed tomography (CT) can lineate the extent of ET, fistulas, and other complications[8] Nevertheless, in mild cases of ET (i.e. exudative phase) other noninvasive treatments like instillation of intrapleural fibrinolytics may be comparable to surgical intervention.[9] With all this in mind, surgery is still the mainstay of treatment in cases who failed to be treated with medical therapy, and higher stages of ET.

Both VATS and conventional thoracotomy is used widely around the world for the treatment of ET in children. Recent studies reported the equal or better outcomes for VATS. For example, In a comparative of 60 cases, VATS had better outcomes compared to thoracotomy, in terms of less pain, hospital stay, and the need for prolonged chest tube drainage.[10] Also, there are more studies with the same design, which reported similar results.[11-12] Moreover, some investigations showed VATS could be safe and feasible in higher phases of ET.[13-14] In the present study, we could not be able to show significant lower length of hospital stay, while like other

studies, the rate of postoperative complications and wound infections was significantly lower than the thoracotomy group.

Unfortunately, this study has several limitations that should be taken into consideration. Firstly, the sample size was relatively small, which may affect the generalizability of the findings. Secondly, the study was conducted in a single center, and therefore, the results may not be applicable to other institutions with different patient populations and surgical practices. Thirdly, the retrospective design of the study may have led to potential selection bias and information bias. Fourthly, although efforts were made to control for confounding factors, the possibility of unmeasured or residual confounding cannot be completely ruled out. Finally, the follow-up period of the study was relatively short, and longer-term outcomes were not evaluated.

Conclusion

In conclusion, this study suggests that video-assisted thoracoscopic surgery (VATS) is a feasible alternative to thoracotomy for the treatment of empyema thoracis. Although there was no statistically significant difference in terms of length of stay and admission days between the two groups, VATS resulted in significantly lower rates of wound infection, pneumothorax, retained hemothorax, and emphysema. Therefore, VATS can be considered as a safe and effective surgical intervention for patients with empyema thoracis. However, further larger-scale studies are needed to confirm these findings.

Ethical Consideration

This study received ethical code from the ethical committee of Shahid beheshti university of medical sciences (IR.SBMU.MSP.REC.1400.654).

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Conflict of interests

There is no conflict of interest

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