Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.277400.3256 Volume 31, Issue 1.1, JAN. 2025, Supplement Issue
Manuscript id ZUMJ-2403-3256
Doi 10.21608/ZUMJ.2024.277400.3256
Original Article

Thoracoscopic Management of Empyema Thoracis in Pediatrics; Effectiveness and Early Outcomes

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Submit date 18-03-2024
Revise Date 11-04-2024
Accept date 26-04-2024

ABSTRACT

Background: Empyema is one of the most common diseases in children, with an excellent prognosis upon appropriate treatment in the early course of the disease. Multiple studies demonstrated that compared to thoracocentesis or chest tube alone, the use of VATS significantly decreases the length of hospital stay. Performing VATS as the primary intervention early in the hospital course can decrease the length of hospital stay, as shown in different studies. This study compares the efficacy of video-assisted thoracoscopic surgery (VATS) in managing empyema in pediatrics compared to classic drainage using an intercostal tube alone.

Methods: The study included 61 pediatric patients with empyema thoracis, who were divided into two groups: A (chest tube only) and B (thoracoscopic drainage). Patients were discharged once their clinical condition improved, after which a three-month follow-up was completed.

Results: Group A included 37 patients (17 males and 20 females), while Group B comprised 24 patients (11 males and 13 females). Fever was the most frequently presenting symptom in both groups, followed by cough and dyspnea. The hospital stay was significantly shorter in Group B, with a significant difference in the radiological improvement upon early follow-up after one week. No difference was observed in late follow-up after three months.

Conclusions: Thoracoscopic drainage of empyema thoracis in the pediatric population has several advantages over conventional chest tube drainage, such as shorter hospital stays and earlier improvement. We recommend the implementation of thoracoscopic drainage of empyema whenever feasible for better outcomes.

Keywords: empyema thoracis; video-assisted thoracoscopic surgery;chest tube drainage.

INTRODUCTION

Empyema is purulent fluid collection in the pleural space that typically complicates acute bacterial pneumonia. It is one of the most common diseases in children, with excellent prognosis upon appropriate treatment in the early stages of the disease. [1]

Different management options for childhood empyema are available. The mainstay treatment of parapneumonic effusion is antibiotics, and surgical interventions and drainage procedures have always played a role in treating empyema. [2,3]

Generally, accepted treatment modalities in the order of minimal to most invasive include antibiotics, intercostal chest drainage, fibrinolytic therapy, video-assisted thoracoscopic surgery (VATS), and open thoracotomy, with open thoracotomy being restricted to treating the most advanced stages. [4,5]

Several studies revealed that compared to thoracocentesis or chest tube alone, using VATS significantly decreases the length of hospital stay. Performing VATS as the primary intervention early in the hospital course can reduce hospital stay length, as shown in different studies. [6,7]

We conducted this study to compare the efficacy of video-assisted thoracoscopic surgery (VATS) in managing empyema in pediatrics compared to classic drainage using an intercostal tube alone.

METHODS

This prospective study was performed in the Cardiothoracic Surgery Department, Menoufia university hospital between January 2022 and August 2023. The study included 61 pediatric patients presented with empyema thoracis after being approved by the local ethics committee of the related faculty of medicine.

Patients were included in the study after being diagnosed with empyema. Both sexes under 16 years were included.

Critically ill patients who were vitally unstable due to significant comorbidities or mechanically ventilated cases due to non-respiratory causes were excluded from our study.

The study was approved by the local ethics committee of the Faculty of Medicine, Menoufia University under the number: 4/2023CARS 15-3. Informed consent to participate was signed by parents of included cases before starting the study.

Patients fulfilling the above criteria were subjected to full history taking and examination. Chest X-ray was conducted before drainage and CT (computed tomography) chest when needed. A pleural fluid sample was sent for biochemical analysis and bacteriological culture. Pleural effusion drainage either by chest tube only (Group A) was done in 37 cases and VATS (Group B) was done in 24 cases.

Surgical Details

In Group A, the chest tube was inserted after administering the sedation and infiltrating local anesthetics. The drain was usually inserted in the mid-axillary line through the fifth space unless loculated effusion necessitated insertion in another spot.

In Group B, all children were subjected to general anesthesia using a single-lumen endotracheal tube after connecting the monitoring devices. Most cases were completed through a single port, i.e., uniport VATS. A minority of cases needed adding one more port as a camera port, while the essential was a utility port.

Suction and frequent flushing using warm saline were conducted before debridement of the pleural space. Partial pleurectomy and opening of any encystment were done when needed. The drain is fixed after completing the procedure by washing with antibiotics added to saline.

Afterward, patients were transferred to the ward or intensive care unit according to their condition. The data were collected and compared in both groups. The follow-up of the included cases continued for three months comparing the degree of improvement in follow up CT chest.

STATISTICAL ANALYSIS

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Categorical data were represented as numbers and percentages. The chi-square test was applied to compare between two groups. Alternatively, Fisher's exact correction and Monte Carlo correction tests were used when more than 20% of the cells had an expected count of less than 5. For continuous data, they were tested for normality by the Shapiro–Wilk test. Quantitative data were expressed as range (minimum and maximum), mean, standard deviation, and median. A Student *t*-test was used to compare two groups for normally distributed quantitative variables. Conversely, the Mann–Whitney test was used to compare two groups for quantitative variables that were not normally distributed. The significance of the obtained results was judged at the 5% level.

RESULTS

As mentioned before, the patients included were divided into two groups. The different parameters are presented in Table 1. The hospital stay was significantly shorter in Group B.

Regarding the operative data of Group B, the mean operative time was 58.3 ± 14.9 min. Two cases (8.3%) required conversion to thoracotomy due to bloody field impairing good vision, hindering the completion of the procedure. One case (4.2%) was returned to the operation room for complete decortication due to lung entrapment.

The outpatient follow-up data are presented in Table 2, demonstrating a significant improvement in early follow-up and no difference in late follow-up.

Table 1: Comparison between the two studied groups according to different parameters.

	Group A (n = 37)	**Group B (n = 24)**	**Test of Sig.**	**P value**
Gender				
Male	17 (45.9%)	11 (45.8%)	χ^2=0.0	0.993
Female	20 (54.1%)	13 (54.2%)		
Age (years)				
Mean ± SD	6.38 ± 2.60	7.88 ± 2.64	t= 2.184*	0.033*
Median (Min.–Max.)	6 (2–12)	8 (3–12)		
Symptoms				
Fever	31 (83.8%)	19 (79.2%)	χ^2=0.210	FEp=0.738
RD	26 (70.3%)	17 (70.8%)	χ^2=0.002	0.962
Cough	23 (62.2%)	15 (62.5%)	χ^2=0.001	0.979
Chest X-ray				
Right	22 (59.5%)	15 (62.5%)	χ^2=0.056	0.812
Left	15 (40.5%)	9 (37.5%)		
CT chest				
Free	26 (70.3%)	17 (70.8%)	χ^2=0.002	0.962
Encysted	11 (29.7%)	7 (29.2%)		
Isolated organism				
No growth	9 (24.3%)	9 (37.5%)	χ^2=1.215	0.270
Staph auerus	5 (13.5%)	3 (12.5%)	χ^2=0.013	FEp=1.000
Pseudomonas	9 (24.3%)	3 (12.5%)	χ^2=1.288	FEp=0.334
Strep pneumoniae	9 (24.3%)	5 (20.8%)	χ^2=0.100	0.751
Strep pyogenes	3 (8.1%)	2 (8.3%)	χ^2=0.001	FEp=1.000
Klebsiella	4 (10.8%)	1 (4.2%)	χ^2=0.854	FEp=0.640
Initial drainage				
Mean ± SD	416.2 ± 179.9	481.3 ± 182.9	U= 346.0	0.145
Median (Min.–Max.)	400 (200–850)	425 (250–800)		
Duration				
Mean ± SD	12.4 ± 3.40	7.42 ± 2.24	t= 6.863*	<0.001*
Median (Min.–Max.)	12 (7–20)	7.50 (4–12)		
Radiological improvement				
Complete	26 (70.3%)	20 (83.3%)	χ^2= 1.340	0.247
Incomplete	11 (29.7%)	4 (16.7%)		

SD: Standard deviation t: Student's *t*-test U**:** Mann–Whitney test
χ^2: Chi-square test FE**:** Fisher's exact
p: p value for comparing between the studied groups
*Statistically significant at $p \leq 0.05$
Group A: Chest tube only Group B: VATS

Table 2: Comparison between the two studied groups according to outpatient follow-up.

Outpatient follow-up	Group A (n = 37)	Group B (n = 24)	χ^2	P
1 week				
Complete	14 (37.8%)	19 (79.2%)	10.749*	$^{MC}p=0.015^*$
Less than 25 % pleural effusion	13 (35.1%)	2 (8.3%)		
Less than 50% pleural effusion	3 (8.1%)	0 (0%)		
Less than 50 % pleural effusion and reinsertion of ICT	2 (5.4%)	1 (4.2%)		
More than 50 % pleural effusion	0 (0%)	0 (0%)		
More than 50 % pleural effusion and reinsertion of ICT	5 (13.5%)	2 (8.3%)		
1 month				
Complete	28 (75.7%)	19 (79.2%)	1.973	$^{MC}p=0.709$
Less than 25 % pleural effusion	7 (18.9%)	3 (12.5%)		
Less than 50% pleural effusion	1 (2.7%)	2 (8.3%)		
Less than 50 % pleural effusion and reinsertion of ICT	1 (2.7%)	0 (0%)		
3 months				
Complete	35 (94.6%)	23 (95.8%)	0.048	$^{FE}p=1.000$
Less than 25%	2 (5.4%)	1 (4.2%)		

χ^2: Chi-square test MC: Monte Carlo FE: Fisher exact
p: p value for comparing between the studied groups
*Statistically significant at $p \leq 0.05$
Group A: Chest tube only
Group B: VATS

DISCUSSION

Proper management of empyema in children is associated with excellent prognosis. Early drainage and antibiotic coverage are the mainstay in treating these patients. The most effective drainage method is still debatable. Advances in thoracoscopic surgery paved the way for its implementation in pediatrics.

As a less invasive intervention, thoracoscopic debridement or decortication is considered an adequate treatment modality. We study the outcome of empyema drainage by chest tube only in comparison to thoracoscopic surgery to reach better management of these cases.

In total, 61 cases were enrolled in the study: 37 were drained using a chest tube (Group A) and 24 underwent thoracoscopic drainage. Sex distribution was comparable to Brohi *et al*., [8] who used primary thoracoscopic drainage in 65 patients, including 38 males and 27 females. Moreover, Peters *et al*. [6] had an equal number of males and females in their study; ours had quite a higher number of female patients.

Furthermore, the included group age was almost near that of Brohi *et al*., [8] but slightly higher than Peters *et al*., [6] who underwent thoracoscopic debridement on patients aged between two and six years.

Regarding the presenting symptoms, fever was the most frequent, followed by respiratory distress and cough. Ho *et al*., [7] included 30 cases in their study of surgical debridement and stated that fever and cough presented in all cases. This coincides with the nature of the disease. Respiratory distress was reported less frequently, at approximately 70%, compared to the 80% reported by Ho *et al*. [7] This percentage was higher than those reported by Peters *et al*. [6] (42%) and Brohi *et al*. [8] (29%). This can be explained by the excellent reserve in otherwise healthy children.

The right side was affected in nearly two-thirds of cases in both groups. Ho *et al*. [7] had a similar distribution, while Peters *et al*. [6] involved 64% of cases with affected left side. In our practice, the right side is primarily affected by parapneumonic effusion and empyema, which can be secondary to aspiration pneumonia, which is the most common cause in this age group.

Nearly one-third of cases had no organism isolated on bacterial culture, primarily due to antibiotics administered before presentation. *Streptococcus pneumoniae*, followed by *Pseudomonas* and *Staph.*

aureus, were the frequently isolated organisms in our study. Ho *et al*. [7] stated that *Streptococcus pneumonia* and *Klebsiella* were most frequent. All results support the fact that *Streptococcus pneumoniae* is the most common causative organism in bacterial pneumonia.

Most cases (22 cases) in Group B underwent operation using uniport VATS with a mean operation time of 58 min. Parelkar *et al*. [2] compared primary and secondary thoracoscopic management of empyema in children, where the mean operation time was slightly longer (90 min). They also used the two-port technique in their study. Brohi *et al*. [8] had a mean time of 66 min using the three-port technique, whereas Ho *et al*. [7] had a longer operation time of 2 to 4 hours. They also used a different surgical technique in their study, that is, surgical decortication. Furthermore, our focus was on drainage and debridement only, not full decortication, especially in the early stages.

The encountered complications were conversion to thoracotomy, air leak, and return to operation. Conversion was needed in two cases (8.3%) due to bleeding obscuring vision. This is considered a high rate compared to those of Peters *et al*. [6] (2.8%) and Brohi *et al*. [8] (3%). This can be attributed to the larger number of patients in these studies and the different training levels of operating personnel.

We have only one case (4.2%) that was returned to the operation room for complete decortication due to lung entrapment. We used low suction connected to the underwater seal to help early drainage and lung expansion. This also helps shorten the hospital stay.

The systemic review prepared by Pacilli *et al*. [3] stated that length of stay and reintervention were significantly lower in cases managed by VATS than those treated with chest tube only or chest tube and fibrinolysis. This was confirmed in our study, demonstrating a significant difference in the hospital stay between both groups in favor of thoracoscopic drainage.

The hospital stay was significantly shorter in the VATS group than that in the chest tube drainage group. This agreed with the results in other involved studies. Mohajerzadeh *et al*. [9] stated shorter duration in the thoracoscopic versus thoracotomy group. In our study, we noted a shorter hospital stay in the thoracoscopic group than their findings indicated. This is supposed to be cost-effective in such common pathology in the pediatric population.

Outpatient follow-up with clinical assessment and radiology was performed after one week, one month, and three months to assess improvement. As shown in the results section, a significant radiological improvement was observed in the early follow-up, favoring thoracoscopic drainage.

CONCLUSIONS

Thoracoscopic drainage of empyema thoracis in the pediatric population has several advantages over conventional chest tube drainage, such as shorter hospital stay and earlier improvement.

Thus, we recommend the implementation of thoracoscopic drainage of empyema whenever feasible for better outcomes.

Availability of data and material

All data generated and analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

Funding

Self-funded study

Acknowledgements

We acknowledge all our department staff in cardiothoracic surgery department, Menoufia university for their continuous support.

REFERENCES

1. *Fernando M, Eitan K, Anne B C, Andrew A C, Heather J Z, Andrew B. (2020) Complicated pneumonia in children. The Lancet;396(10253) 786-798.*
2. *Parelkar SV, Patil SH, Sanghvi BV, Gupta RK. (2017) Video-Assisted Thoracoscopic Surgery for Pediatric Empyema by Two-Port Technique: A Single-Center Experience with 167 Consecutive Cases. J Indian Assoc PediatrSurg;22(3):150-154.*
3. *Pacilli M, Nataraja RM. (2019). Management of paediatric empyema by video-assisted thoracoscopic surgery (VATS) versus chest drain with fibrinolysis: Systematic review and meta-analysis. Paediatr Respir Rev; 30:42-48.*
4. *Shen KR, Bribriesco A, Crabtree T, Denlinger C, Eby J, Eiken P, et al. (2017) Thoracic: AATS expert consensus guidelines: empyema "The American Association for Thoracic Surgery consensus guidelines for the management of empyema". The Journal of Thoracic and Cardiovascular Surgery 153.6: e129-146.*
5. *Maurizio P, Ramesh MN. (2019) Management of paediatric empyema by video-assisted thoracoscopic surgery (VATS) versus chest drain with fibrinolysis: Systematic review and meta-analysis. Paediatric Respiratory Reviews; 30:42-48.*

6. *Peters RT, Parikh DH, Singh M, (2020). Thoracoscopic debridement for empyema thoracis. Journal of Pediatric Surgery;55(10):2187-90.*
7. *Ho YL, Jamaluddin MF, Krishinan S, Salleh A, Khamis AY, Abdul Kareem BA. (2020) Pediatric empyema thoracis: roles and outcomes of surgery in advanced disease. Asian Cardiovascular and Thoracic Annals;28(3):152-157.*
8. *Brohi AR, Mengal N, Leghari AL. (2022) "Role of Primary Vats for the Treatment of Empyema Thoracis in Children". Acta Scientific Paediatrics 5.5: 37-41.*
9. *Mohajerzadeh L, Lotfollahzadeh S, Vosoughi A, Harirforoosh I. (2019) Thoracotomy versus Video-Assisted Thoracoscopy in Pediatric Empyema. Korean J Thorac Cardiovasc Surg;52(3):125-130.*

Citation

Khalil, I., Abd El-Sadek, S., Nashy, M. Thoracoscopic management of empyema thoracis in pediatrics; effectiveness and early outcomes. *Zagazig University Medical Journal*, 2025; (352-357): -. doi: 10.21608/zumj.2024.277400.3256