

# Outcomes of Video-Assisted Thoracoscopic Decortication in Pleural Empyema in Children

## Çocuklarda Plevral Ampiyemde Video Yardımlı Torakoskopik Dekortikasyonun Sonuçları

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### ABSTRACT

**Objective:** The aim of this study is to determine efficacy, safety, and feasibility of video-assisted thoracoscopic surgery (VATS) in childhood empyema with two port technique.

**Material and Methods:** 34 patients under 17 years of age were included to the study. Demographic and clinical data of the patients were recorded retrospectively

**Results:** 34 patients under 17 years of age were included in the study. The first time the complaints started was 12 days. VATS was performed on mean 12 (2-46) days after the complaints of the patients started. The empyemas were in right hemithorax in 21 children and left in 11. Two patients underwent bilateral decortication Mean of chest tube removal time was 9.70 (2-26) days. While the postoperative stay was 23.50 (4-120) days, the total hospital stay was 32.50 (7-142) days. Empyema developed in 7 patients in the following period. Chest tube revision was performed in a patient. Empyema spontaneously regressed at follow-up in 6 patients. Two children died from non-thoracoscopy reasons after respiratory arrest and liver transplantation.

**Conclusion:** VATS is a feasible method with good results pleural empyema in children. The results are satisfactory in the early or late period of disease.

**Key Words:** Child, Empyema, Surgery, Thoracoscopic, VATS



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## ÖZ

**Amaç:** Bu çalışmanın amacı, çocukluk çağı ampiyemide iki port tekniği ile video yardımcı torakoskopik cerrahinin (VATS) etkinlik, güvenlik ve uygulanabilirliğini belirlemektir.

**Gereç ve Yöntemler:** Çalışmaya 17 yaş altı 34 hasta dahil edildi. Hastaların demografik ve klinik verileri geriye dönük olarak kaydedildi.

**Bulgular:** Çalışmaya 17 yaş altı 34 hasta dahil edildi. Şikayetlerin ilk başladığı gün 12 gündü. Hastaların şikayetleri başladıktan ortalama 12 (2-46) gün sonra VATS uygulandı. Ampiyem 21 çocukta sağ hemitoraksta, 11 çocukta sol taraftaydı. İki hastaya bilateral dekortikasyon uygulandı. Drenaj için takılan göğüs tüpünün çıkarılma süresi ortalama 9.70 (2-26) gündü. Ameliyat sonrası kalış süresi 23.50 (4-120) gün iken, toplam hastanede kalış süresi 32.50 (7-142) gündü. Takipler sırasında 7 hastada amfizem gelişti. Bir hastaya göğüs tüpü revizyonu yapıldı. 6 hastada spontan geriledi. İki çocuk solunum arresti ve karaciğer nakli sonrası torakoskopi dışı nedenlerden exitus oldu.

**Sonuç:** VATS, çocuklarda plevral ampiyemde sonuçları iyi olan, uygulanabilir bir yöntemdir. Sonuçlar hastalığın erken veya geç döneminde tatmin edicidir.

**Anahtar Sözcükler:** Çocuk, Ampiyem, Cerrahi, Torakoskopik, VATS

## INTRODUCTION

Pleural empyema is defined as purulent fluid accumulation in the pleural cavity. Common conditions associated with this disease include pneumonic processes in patients with pulmonary and malignant diseases, heart disease, diabetes mellitus, drug and alcohol abuse, neurological disorders, post-thoracotomy problems, and immunological disorders (1). Nowadays, thoracic empyema occurs in 1 of 150 children hospitalized with pneumonia (1).

Treatment methods include parenteral antibiotics, intrapleural fibrinolytic injections (streptokinase), video assisted thoracoscopic surgery (VATS) and open thoracotomy.

Empyema is characterized by three stages (1). Treatment varies by stage. Stage 1: exudative stage, parapneumonic effusion developing in the first 24-72 hours. Treatment with intravenous antibiotics and simple thoracentesis is preferred. Stage 2: fibrinopurulent stage lasts 7-10 days. The third stage, or organized stage, occurs 2-4 weeks after the first symptom. Thickening of the visceral and parietal pleura is characterized by cavities composed of fibrins extending into the lung parenchyma. In the 2<sup>nd</sup> and 3<sup>rd</sup> stages, additional thoracoscopy or thoracotomy is preferred.

Early parenteral antibiotic therapy may be sufficient for some cases and intervention may not be needed (2 for those who fail to respond, an open thoracotomy and formal decortication. Since the 1990s two new treatment modalities have been described; fibrinolysis (promoting pleural drainage and circulation). But it is controversial whether perform VATS or fibrinolytic injection in resistant cases (2 for those who fail to respond, an open thoracotomy and formal decortication. Since the 1990s two new treatment modalities have been described; fibrinolysis (promoting pleural drainage and circulation). In authors center VATS is the method of choice since it was recommended as the gold Standard approach by American Association of Thoracic Surgeons in 2017 (shenguideline).

Most cases respond to antibiotic therapy and intercostals drainage in earlier stages; however, in majority of cases surgical management is required due to delayed presentations, multiresistant strains, delayed diagnosis, poor compliance with medication at early stages of the disease. A meta-analysis

performed regarding management of paediatric empyema thoracis has shown that primary operative therapy is associated with lesser mortality, decreased hospital stay, shorter duration of antibiotic therapy and less chances of reintervention (3,4) decortication is usually preferred to ensure functional lung re-expansion. However, there could be patients exhibiting incomplete postoperative lung expansion and inadequate drainage despite decortication. Therefore, we evaluated factors affecting postoperative lung expansion in patients undergoing decortication. Methods A total of 221 patients with pyogenic empyema who underwent video-assisted thoracoscopic surgery (VATS).

In this study, it was aimed to present the results of VATS procedures in children who admitted to the clinic with empyema at different stages.

## MATERIAL and METHODS

This study was approved by Ankara University Human Research Ethics Committee (Approval no: İ6-369-20).

34 patients under 17 years of age were included to the study. Age, gender, weight, time between onset of symptoms and hospital apply, stage of disease accompanying diseases, hospital stays and perioperative complications are analyzed retrospectively. The patients were classified according to the results of computed tomography and clinical complaints. It was investigated whether interventional procedures such as chest tube insertion and thoracentesis were performed before VATS. Reoperation and mortality were also taken into consideration. General anesthesia was performed in all cases. The patient was positioned in lateral decubitus while appropriate side up. One camera port and one access port were used. For this, usually the 4<sup>th</sup>, 5<sup>th</sup> or 6<sup>th</sup> intercostal spaces; anterior, middle and posterior axillary lines were preferred. Decortication and aspiration were performed with generally blunt dissections and fibrins were excised. A chest tube was inserted (Figure 1).

Patients were extubated in the operating room and controlled with postoperative chest radiographs in early postoperative period. Early mobilization was recommended. Intravenous antibiotics were continued. Tube removal was planned when



**Figure 1:** Intraoperative image



**Figure 2:** Preoperative, postoperative first and last X-ray images

there was no air leak and/or incoming fluid (Figure 2).

The patients were discharged after the decision taken after the children were evaluated by surgery, infectious diseases and pulmonology departments and recommended a visit with a chest X-ray at postoperative first week.

Results were expressed at mean values 6 SEM. Student's t test for paired data was used for quantitative variables and either  $\chi^2$  or Fisher's test for qualitative variables. Statistical significance was determined at p less than 0.050.

## RESULTS

34 patients under 17 years of age were included in the study. Ten of them were women and 24 were men. Their average age was 67.38 (8-210) months, and their average body weight was 25 (8-90) kg. When the staging was examined, it was observed that six patients were stage 2 and 28 patients were stage 3. Left-sided empyema was found in 11 children, while 21 children had right-sided empyema. Bilateral empyema was observed in 2 patients. In these patients, bilateral decortication was performed in the same session. Two children underwent contralateral VATS after 2.5 months of the first operation. The first time the complaints started was 12 days. Additional disease was observed in ten patients (glaucoma, ADEM, inguinal hernia, AML, pineal dysgerminoma, immunodeficiency, PFIC 2, Down syndrome, polyneuropathy, splenectomy). VATS was performed on mean 12 (2-46) days after the complaints of the patients started. Chest tube was placed in 11 patients

**Table I: Patient details classified by stage**

Stage	Stage 2	Stage 3
Patients (n)	6	28
Age (month)	116	57
Weight (kg)	35	22.8
Sex (F/M)	1/6	9/19
Side (R/L/Bilateral)	4/2/0	17/9/2
Thoracentesis/chest tube before VATS (days)	6/9	2/2
Chest tube removal after VATS (days)	5.5	10.6
Comorbidity	2	8
Hospital stay (days)	24.6	34.1
Complications	0	7
Exitus	1	1

before VATS in emergency situations in other centers. Mean of chest tube removal time was 9.70 (2-26) days. While the postoperative stay was 23.50 (4-120) days, the total hospital stay was 32.50 (7-142) days. The intraoperative pleural culture of nine patients were tested positive for *Streptococcus pneumoniae* (n=6), *Acinetobacter baumannii* (n=1), *Bacillus spp* (n=1), *Pseudomonas aeruginosa* (n=1). Emphysema developed in 7 patients in the following period. Chest tube revision was performed in a patient. Emphysema regressed at follow-up in 6 patients. Two children died from non-thoracoscopy reasons after respiratory arrest and liver transplantation. There were no complications related to surgery in the postoperative period. The first patient died 3 months later, the second patient 1 year later. Detailed data are shown in Table I.

## DISCUSSION

As a result of VATS performed on 34 patients with stage 2 and stage 3 empyema, a cure rate of 94% was observed.

Over time, VATS has become more common treatment for children with pleural empyema (4). Although it was more preferred in stage 3 patients before, it has now began to be performed in lower stages more and more (6,7). Besides the less invasive nature of VATS, the shorter hospital stay and fewer postoperative complications are among the reasons for preference rather than thoracotomy (1,6-10).

In terms of surgical technique and convenience, VATS is safe and effective in the treatment of complicated parapneumonic effusion and pleural empyema (8). VATS has been shown to be a feasible option if there is sufficient surgical equipment and experience (8).

One of the other commonly used treatment options is fibrinolytic therapy. Although the invasiveness of fibrinolytic therapy is low, there are sources showing that the results do not differ significantly, and that VATS is a safer option (9). There

are also studies supporting the opposite (10). However, it has been reported that fibrinolytic therapy will be of limited value in patients with multiloculated parapneumonic effusion or empyema, and that fibrinolytic agents have side effects such as anaphylaxis, bleeding, and pulmonary edema (11). In our study, these complications were not observed in patients who underwent VATS as expected.

Leily Mohajerzadeh et al. (1) showed that based on a comparison of the advantages and disadvantages of thoracotomy and VATS for the treatment of empyema, it seems that the less invasive VATS technique is suitable for the management of pediatric patients with empyema, since it was associated with a shorter hospital stay, a lower rate of postoperative complications, and less bleeding during the operation. It is very important to pay attention to maintain psychological balance when working with pediatric patients. As Rodriguez et al. (12) presented, thoracoscopic surgery creates less psychological and physical trauma in children compared to thoracotomy. The cosmetic aspect of the surgery also gives better results. Avoiding thoracotomy allows the child to be nearly scar free with only two or at most three five millimeters port scars (12,13). This cosmetic success may also prevent the psychological damage to the growing child.

Although VATS was performed mostly in advanced stage of empyema patients in the past, recent studies have proved that VATS may be even more beneficial in the early stage of the disease (7,8,12). Velaiutham et al. (7) demonstrated in a 24-patient study that early primary VATS therapy as a first-line intervention for pediatric empyema can be safely implemented with lower morbidity, lower intervention rate, improved outcome, and shorter hospitalization. The fact that none of the 6 patients with stage 2 in our study developed complications in the postoperative period supports this finding.

Retrospective collection of data and relatively small number of cases were among few limitations of the study. Also lack of a control group which includes children that undergo fibrinolytic therapy is another one. It was aimed to minimize this limitation by comparing our data to the literature on fibrinolytic therapy.

## CONCLUSION

In conclusion, VATS seems to be a feasible method with good results in children with pleural empyema. Randomized prospective studies with larger amount of patients on treatment options and also timing of the intervention may be beneficial for further comments.

## REFERENCES

- Mohajerzadeh L, Lotfollahzadeh S, Vosoughi A, Harirforoosh I, Parsay S, Amirifar H, et al. Thoracotomy versus video-assisted thoracoscopy in pediatric empyema. *Korean J Thorac Cardiovasc Surg* 2019;52:125–30.
- Cremonesini D, Thomson AH. How should we manage empyema: Antibiotics alone, fibrinolytics, or primary video-assisted thoracoscopic surgery (VATS)? *Semin Respir Crit Care Med* 2007;28:322–32.
- Ahn HY, Cho JS, Kim YD, Hoseok I, Song S, Eom JS, et al. Factors Affecting Postoperative Lung Expansion in Patients with Pyogenic Empyema. *Thorac Cardiovasc Surg* 2018;66:697–700.
- Majeed FA, Chatha SS, Zafar U, Chatha UF, Chatha AZ, Farooq Z. Surgical management of paediatric empyema: Open thoracotomy versus video-assisted thoracic surgery. *J Coll Physicians Surg Pakistan* 2020;30:309–12.
- Subramaniam R, Joseph VT, Tan GM, Goh A, Chay OM. Experience with video-assisted thoracoscopic surgery the management of complicated pneumonia in children. *J Pediatr Surg* 2001;36:316–9.
- Barglik R, Grabowski A, Korlacki W, Pasierbek M, Modrzyk A. Pleural empyema in children – Benefits of primary thoracoscopic treatment. *Wideochirurgia I Inne Tech Maloinwazyjne* 2021;16:264–72.
- Pogorelič Z, Bjelanović D, Gudelj R, Jukić M, Petrić J, Furlan D. Video-Assisted Thoracic Surgery in Early Stage of Pediatric Pleural Empyema Improves Outcome. *Thorac Cardiovasc Surg* 2021;69:475–80.
- Tong BC, Hanna J, Toloza EM, Onaitis MW, D'Amico TA, Harpole DH, et al. Outcomes of Video-Assisted Thoracoscopic Decortication. *Ann Thorac Surg [Internet]* 2010;89:220–5.
- Velaiutham S, Pathmanathan S, Whitehead B, Kumar R. Video-assisted thoracoscopic surgery of childhood empyema: Early referral improves outcome. *Pediatr Surg Int* 2010;26:1031–5.
- Zhang Y, Xie Y, Luo Y, Xiang S, Zhong W, Wu N, et al. Massive secretions in paragonimiasis pleural effusion: a new finding concerning clinical recognition and treatment. *Eur J Clin Microbiol Infect Dis* 2023;42:493–501.
- Luh S-P, Chou M-C, Wang L-S, Chen J-Y, Tsai T-P. Video-Assisted Thoracoscopic Surgery in the Treatment of Complicated Parapneumonic Effusions or Empyemas. *Chest [Internet]* 2005;127:1427–32.
- Livingston MH, Colozza S, Vogt KN, Merritt N, Bütter A. Making the transition from video-assisted thoracoscopic surgery to chest tube with fibrinolytics for empyema in children: Any change in outcomes? *Can J Surg* 2016;59:167–71.
- St. Peter SD, Tsao K, Harrison C, Jackson MA, Spilde TL, Keckler SJ, et al. Thoracoscopic decortication vs tube thoracostomy with fibrinolysis for empyema in children: a prospective, randomized trial. *J Pediatr Surg [Internet]* 2009;44:106–11.
- Lok S, Davies RJO. The systemic fibrinolytic activity of intra-pleural streptokinase in humans. *Thorax* 1996;51:328–30.
- Rodriguez JA, Hill CB, Loe WA, Kirsch DS, Liu DC. Video-assisted thoracoscopic surgery for children with stage II empyema. *Am Surg* 2000;66:569–72.
- Parelkar SV, Patil SH, Sanghvi BV, Gupta RK, Mhaskar SS, Shah RS, et al. Video-Assisted Thoracoscopic Surgery for Pediatric Empyema by Two-Port Technique: A Single-Center Experience with 167 Consecutive Cases. *J Indian Assoc Pediatr Surg* 2017;22:150–4.