International Surgery Journal
*Trivedi SG et al. Int Surg J. 2026 Sep;13(9):1674-1679*
https://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20262994

**Original Research Article**

# Management of empyema in paediatric patients: experience at a tertiary care centre

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**Received:** 28 June 2026
**Revised:** 06 August 2026
**Accepted:** 17 August 2026

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## ABSTRACT

**Introduction:** Lung empyema is an ancient disease that remains a significant clinical problem in paediatric patients. The most common precursor is bacterial pneumonia and subsequent pleural effusion. Despite widespread antibiotic use and pneumococcal vaccines, empyema continues to be a major complication of pneumonia and a leading cause of morbidity and mortality worldwide.
**Methods:** A retrospective review of medical records of paediatric patients diagnosed with lung empyema at Parul Sevashram Hospital from January 2022 to August 2025 was conducted. Treatment modalities ranged from conservative management (injectable antibiotics) to surgical interventions, including intercostal drainage (ICD) tube insertion, intrapleural streptokinase therapy, video-assisted thoracoscopic surgery (VATS), and thoracotomy.
**Results:** Sixty patients were included in the study. 20 were treated conservatively with injectable antibiotics. Surgical interventions were employed in 40 patients: ICD insertion (40 patients), intrapleural streptokinase (16 patients), VATS (2 patients), and thoracotomy (16 patients).
**Conclusion:** This study compares the management of lung empyema at different stages and evaluates associated morbidity and mortality.

**Keywords:** Empyema, Paediatric, Pneumonia, Intercostal drainage tube, Streptokinase, VATS, Thoracotomy

## INTRODUCTION

Thoracic empyema, characterized by purulent fluid in the pleural space, poses a significant clinical challenge, particularly in the paediatric population.[1] It typically arises as a complication of pneumonia, involving complex pathophysiological processes of infection and inflammation.[2] Common causative organisms include Gram-negative and anaerobic bacteria, with tuberculous empyema also observed. Symptoms include fever, malaise, anorexia, weight loss, cough, and dyspnoea.[1] The present research article describes our institutional experience with pediatric empyema, where treatment was tailored according to disease stage and radiological findings. Outcomes of conservative management, chest tube drainage, intrapleural streptokinase therapy, VATS, and thoracotomy with decortication are presented to highlight the effectiveness of a stage-based approach in a tertiary referral centre.

### *Review of literature*

Empyema thoracis remains one of the most significant complications of pediatric pneumonia despite advances in antimicrobial therapy and supportive care. Contemporary management has evolved considerably over the past two decades, shifting from prolonged conservative treatment towards early intervention based on the pathological

stage of the disease. Jones and Ferguson described empyema as a progressive inflammatory process involving the pleural cavity, beginning with sterile pleural effusion and advancing through fibrin deposition to organization with dense pleural fibrosis. They emphasized that treatment outcomes are closely related to early diagnosis and appropriate stage-specific intervention rather than the duration of symptoms alone.[1]

The American Pediatric Surgical Association (APSA) conducted a systematic review evaluating the management of pediatric empyema and concluded that both intrapleural fibrinolytic therapy and VATS achieve high rates of treatment success. The authors found no convincing evidence supporting the universal superiority of one technique over the other and recommended that management should be individualized according to disease severity, institutional resources, and surgical expertise.[2]

Similarly, the British thoracic society guidelines recommend prompt initiation of broad-spectrum intravenous antibiotics in all children with pleural infection, followed by pleural drainage whenever significant pleural collections or respiratory compromise are present. Thoracic ultrasonography is considered the imaging modality of choice because it accurately identifies septations and guides drainage procedures without exposing children to ionizing radiation.[3]

The role of conservative therapy is largely confined to patients presenting during the early exudative stage. Jaffe and Balfour-Lynn reported that selected children with free-flowing pleural effusions often recover with antibiotics alone when closely monitored. However, progression to loculated empyema usually requires additional intervention because antibiotics penetrate poorly into fibrinous septations and organized collections.[4]

Intercostal chest tube drainage continues to represent the cornerstone of management in the fibrinopurulent phase. Placement of a drainage catheter facilitates evacuation of infected pleural fluid, improves lung re-expansion, and permits microbiological analysis. Nevertheless, drainage may remain inadequate when multiple loculations are present, resulting in persistent fever, prolonged hospitalization, and treatment failure.

To overcome this limitation, intrapleural fibrinolytic agents have become widely accepted in pediatric practice. Urokinase and streptokinase dissolve fibrinous septations, improve pleural drainage, and reduce the need for surgical intervention in appropriately selected patients. Sonnappa and colleagues conducted a randomized controlled trial comparing urokinase with VATS and demonstrated comparable treatment success, duration of hospitalization, and recovery between the two treatment modalities.[5]

Video-assisted thoracoscopic surgery has emerged as an effective minimally invasive alternative for children who fail conservative measures or present with multiloculated empyema. Thoracoscopic visualization allows complete evacuation of purulent material, disruption of septations, and removal of fibrin deposits while minimizing postoperative pain and shortening recovery compared with conventional thoracotomy. Although VATS has gained increasing acceptance, conversion to open surgery may still be required in advanced organized empyema.

Thoracotomy with decortication remains the definitive treatment for patients with dense pleural fibrosis and trapped lung. Although associated with greater surgical trauma, it provides complete removal of the fibrous pleural peel and remains indispensable for children presenting late or after unsuccessful fibrinolytic therapy or thoracoscopic management.

A Cochrane systematic review comparing surgical and non-surgical approaches concluded that current evidence does not demonstrate a consistently superior treatment strategy. Instead, clinical outcomes are largely influenced by disease stage at presentation and the experience of the treating centre. Likewise, the meta-analysis performed by St Peter and colleagues found that primary operative management and fibrinolytic therapy produced similar overall success rates, although early surgery reduced the likelihood of additional procedures in selected patients.[8,9]

### *Aims and objectives*

To compare conservative and surgical management strategies for empyema at different stages.

## METHODS

### *Study type*

This was a retrospective observational study.

### *Study place*

The study place was Parul Sevashram Hospital.

### *Study duration*

The study duration was from January 2022– August 2025.

### *Sample size*

The sample size was 60 paediatric patients.

### *Selection criteria*

Paediatric patients of age upto 17 years, treated for lung empyema with conservative and/or surgical management.

As this was an observational retrospective study, ethical approval and statistical analysis did not imply.

***Investigations***[6,7]

*Chest X-ray*

Initial diagnostic tool.

*Ultrasound chest*

Evaluates septations, assesses pleural fluid volume and guides diagnostic tapping.

*Pleural fluid analysis*

Culture and cytology to confirm exudative effusion and identify pathogens, including *Mycobacterium tuberculosis*.

High-resolution computed tomography (HRCT) thorax (Figure 1).

Pleural thickening and pleural enhancement (if contrast done).

***Stages of empyema***[6,7,9]

*Stage 1 (exudative phase)*

Protein-rich effusion (>30 g/l).

***Common pathogens:*** *Streptococcus milleri, Haemophilus influenzae*. Managed with injectable antibiotics.

*Stage 2 (fibropurulent phase)*

Fluid thickens and loculates. Requires intercostal drainage (ICD) and intrapleural fibrinolytic therapy (e.g., streptokinase).

***Stage 3 (organizing phase)***

Pleural thickening and lung trapping by a fibrous peel. Surgical interventions (VATS or thoracotomy with decortication) are necessary.

***Treatment modalities***

*Conservative management*

Injectable antibiotics (culture-guided), ICD insertion, Intrapleural streptokinase.

***Surgical management***

VATS (Figure 2 and 3). Thoracotomy with decortication. (Figure 4 and 5).

## RESULTS

***Conservative management (20 patients)***

Injectable antibiotics alone resolved symptoms (fever, dyspnoea, chest pain) (Figure 6).

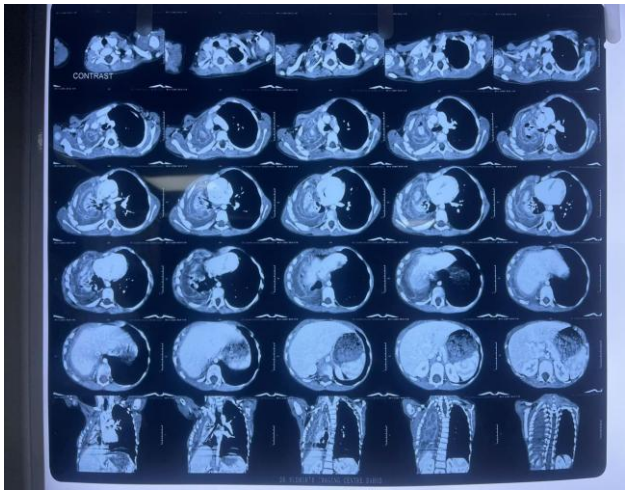


**Figure 1: CT thorax of right-side lung empyema.**

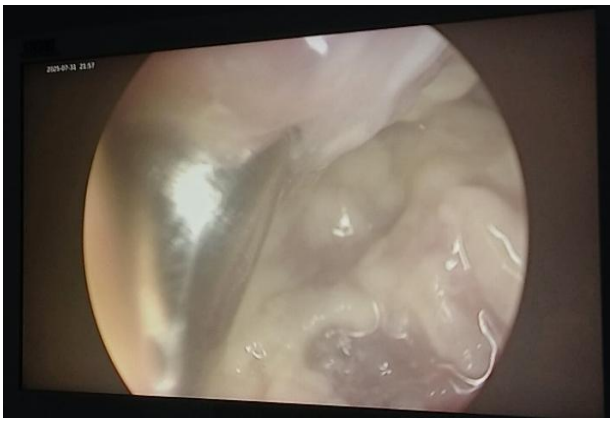

**Figure 2: Video assisted thoracoscopic surgery-before decortication. Thick layers of pus seen in a diagnosed case of tuberculous empyema.**

**Figure 3: Video assisted thoracoscopic surgery-after decortication.**

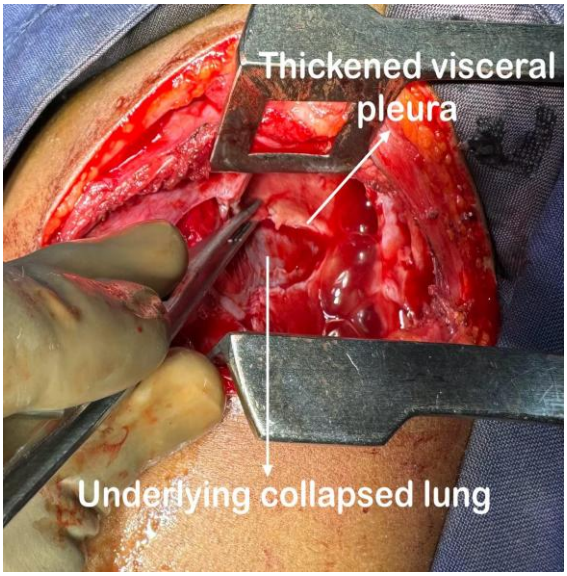


**Figure 4: Underlying collapsed lung with thickened visceral pleura in a patient of lung empyema.**


**Figure 5: Fully expanded lungs after thoracotomy and pleurectomy in a lung empyema patient.**

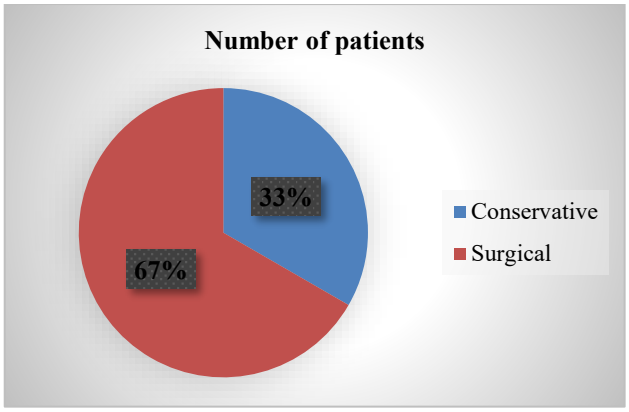


**Figure 6: Treatment-wise distribution of patients.**

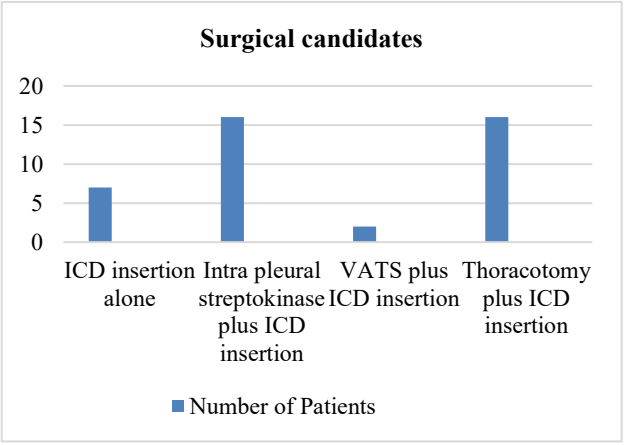


**Figure 7: distribution of patients in different surgical modalities used to treat empyema thoracis.**

***Surgical management (40 patients)***

ICD Insertion was done in 40 patients (Figure 7). 7 of them improved with antibiotic post drainage. Intrapleural streptokinase for loculated effusions with minimal pleural thickening and septations were given in 16 patients. 1 of these had to be taken for surgery. VATS was done in 2 patients for advanced loculations. Thoracotomy was done for thick pleural peel and trapped lung in 16 patients.

**Table 1: Summary of management protocol and respective outcomes in 60 patients treated for lung empyema.**

| Management protocol and outcomes of paediatric empyema (n=60) | | | | |
|---|---|---|---|---|
| **Stage of empyema** | **Key characteristics** | **Primary treatment** | **No. of patients** | **Outcomes & subsequent management** |
| **1: Exudative** | Thin, free-flowing purulent fluid. | IV antibiotics (culture-guided) | 20 | All 20 patients responded well |
| **2: Fibrinopurulent** | Loculated, turbid fluid | ICD insertion+IV antibiotics | 7 | 7 patients had complete drainage and recovered. |
| | ↑ Septations, minimal pleural thickening | ICD+intrapleural streptokinase | 16 | 15 patients recovered successfully with fibrinolytic therapy. 1 patient failed therapy and progressed to stage 3. |

Continued.

| Management protocol and outcomes of paediatric empyema (n=60) | | | | |
|---|---|---|---|---|
| **3: Organizing** | advanced loculations ↑pleural thickness | ICD+surgical intervention (VATS) | 2 | Both patients were successfully cured. |
| | extensive disease referred/late presentation | ICD+surgical intervention (thoracotomy with decortication) | 16 | Preferred procedure for 15 advanced cases referred to our tertiary center and 1 failed from intrapleural streptokinase therapy |

## DISCUSSION

This retrospective study of 60 paediatric patients highlights the importance of stage-specific management for empyema (Table 1). Early-stage disease responds well to antibiotics, while advanced stages require surgical intervention. In the exudative phase, intravenous antibiotics alone have proved to be sufficient for treatment.[5] 20 of the patients presented to us in the exudative phase of disease. These patients were kept on conservative management. Ultrasonography guided diagnostic tapping was done and sent for culture and sensitivity report. Intravenous antibiotics were given as per the culture report. Symptoms like fever, cough and chest pain subsided and patients were continued on antibiotics for 6 weeks.

In the fibrinopurulent phase, intravenous antibiotics alone are not sufficient.[5] Intercostal drainage tube (ICD) insertion is required. Drainage of empyema was noted and subsequent chest X-ray performed. Out of 40 patients in whom ICD was inserted, 23 presented in this phase. 7 of them had complete drainage of empyema and no further symptoms were noted. HRCT thorax was performed in 40 of these patients.[5] 16 patients with increased septations were given intrapleural streptokinase.[3] 15 patients recovered well and 1 required surgical management thoracotomy. In the organizing phase of disease, surgical management is required.[5] ICD was inserted in all of these patients. 2 patients underwent VATS and were successfully cured.[3,5] 16 patients underwent thoracotomy and decortication.[3] The hospital, being a tertiary care centre, received referrals from other hospitals.

These patients presented late, often in this advanced phase, where thoracotomy was the preferred treatment option.[5,7] Barman et al in their study mentioned that conservative management with antibiotics and intervention with intercostal drainage tube proved to be effective in cases presented at early stages.[8] In the study, similarly the patients presented at early stages of empyema were effectively treated with conservative approach such as culture sensitive antibiotics and with drainage from intercostal chest tube. Iranya et al in his study highlighted the challenge they faced because of late presentation, making surgery the only possible treatment.[9]

### *Limitations*

Early intervention in lung empyema can give favorable outcomes with conservative management alone or with Intercostal drainage tube insertion. VATS and Thoracotomy can be thus avoided. But our centre being a referral centre to many peripheries, brings the patients to us in later stages and therefore a greater number of patients had to be taken for surgical management and conservative management alone could not be successful.

## CONCLUSION

The management of pleural infection in our cohort was determined by the disease stage at presentation. Patients in the early exudative phase responded successfully to conservative management with intravenous antibiotics alone. However, those who presented in the more advanced fibro purulent or organizing phases required surgical intervention in addition to antibiotics. As a tertiary referral center, our hospital predominantly receives patients with advanced disease after initial management at other facilities. Consequently, a higher proportion required surgical procedures. All such patients underwent ICD insertion. The specific surgical approach such as intrapleural streptokinase, VATS, or thoracotomy was then decided based on radiological evidence of septations and pleural thickening. The relatively high number of thoracotomies performed is directly attributable to the advanced stage of disease upon referral.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: Not required*

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**Cite this article as:** Trivedi SG, Patel M, Naik J, Iyenger M. Management of empyema in paediatric patients: experience at a tertiary care centre. Int Surg J 2026;13:1674-9.