

# CLINICAL PROFILE AND OUTCOME OF CHILDREN WITH EMPYEMA THORACIS IN TERTIARY HOSPITAL

Vijay Kumar Sah<sup>1\*</sup>, Sandip Kumar Singh<sup>2</sup>, Sunil Kumar Yadav<sup>1</sup>, Arun Giri<sup>1</sup>, Praveen Kumar<sup>3</sup>

## Affiliation

1. Associate Professor, Department of Pediatrics, Nobel Medical College Teaching Hospital-Biratnagar, Nepal
2. Assistant Professor, Department of Pediatrics, Nobel Medical College Teaching Hospital-Biratnagar, Nepal
3. Consultant, Department of Pediatrics, Koshi Zonal Hospital-Biratnagar, Nepal

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## Corresponding Author

Dr. Vijay Kumar Sah

Associate Professor

Department of Paediatrics

Nobel Medical College Teaching Hospital, Nepal

Email: drvks18@gmail.com

ORCID No.: <https://orcid.org/0000-0003-2832-937X>

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## ABSTRACT

### Introduction

Empyema thoracis (ET) is an accumulation of pus in the pleural space. It is a common condition in childhood having significant morbidity and mortality. The clinical manifestations of empyema are high grade fever with chills and rigors, cough, breathlessness, chest pain. The present study analyses the epidemiological aspects of the disease, etiological agents, clinical features and associated lesions in diagnosis of empyema and the outcome of early Video-assisted thoracoscopic surgery (VATS) on morbidity of disease in children.

### Objectives

To study various demographic characteristic and to evaluate various management strategies and outcome in children with empyema thoracis.

### Methodology

This is a prospective hospital based observational study, conducted at Nobel Medical College Teaching Hospital Biratnagar, from December 2021 to November 2022. All children in the age group of 1month to 16 years diagnosed pyogenic empyema by lights criteria during the study are included in the study. Children below 1 month of age and pleural effusion not meeting the criteria for exudative pleural effusion by Light's criteria are excluded from the study.

### Result

Majority of the study population are in the age group of >5 years. Males are more common than females. Most common clinical feature was fever followed by cough, chest pain and shortness of breath. Culture is positive in 68% out of which 32% is staphylococcus aureus, 20% is mycobacterium tuberculosis, 16% is streptococcus pneumonia. Duration of illness is <1week in 48% of the children, 1-2weeks in 40% and >3 weeks in 12% of the children. In 80% of the children there is unilateral involvement in the x- ray chest. In the children who are uncomplicated all of them had intercoastal chest tube drain (ICD) usage, 76.4% had urokinase therapy and 5.8% had undergone thoracotomy and none of them had need for surgery. In the children with complication 87.5% had ICD usage and urokinase therapy, 25% of them had undergone thoracotomy and 12.5% had need for surgery.

### Conclusion

Empyema thoracis is more commonly seen in the males of the group >5 years with duration of illness <1 week managed mostly by ICD usage, where there was mostly unilateral involvement in x ray chest.

## KEY WORDS

Empyema thoracis, Urokinase therapy, VATS.



## INTRODUCTION

Empyema thoracis, the presence of pus in the pleural space develops as a complication of bacterial pneumonia in 5-10% of children.<sup>1</sup> About 0.6% of childhood pneumonias progress to pleural empyema and is a recognized common complication of bacterial pneumonia. In most of the cases, it is of parapneumonic origin. It is usually caused by local spread of infection from pneumonia, tuberculosis or lung abscess but may be caused by organism brought to pleural space via blood or lymphatics or abscess extending upward from below the diaphragm or as a consequence of infection at other sites distant from lung. Less common causes include following surgical procedures, traumas and oesophageal perforation, inhalation of a foreign body, immunodeficiency states such as hypogammaglobulinemia, and immuno suppression after chemotherapy, corticosteroid treatment, or malnutrition but these are rare in children. Conditions are more common in boys than girls and are more frequently encountered in infants and young children. They are also more common in winter and spring, presumably due to their infective origin.<sup>2</sup> Empyema thoracis (ET) is known since Hippocrates' time; nonetheless, incidence is still rising all over the world.<sup>3</sup> Possible reasons could be poverty, ignorance, malnutrition, misdiagnosis, delay in initiating treatment or inadequate/inappropriate treatment of bacterial pneumonia, non-evacuation of pleural space and delayed referral. The incidence of empyema is increasing despite the advent of potent antimicrobial agents resulting in significant childhood morbidity.<sup>4,5</sup>

The pleural space usually contains a small amount of fluid (0.3ml/kg of body weight), which is absorbed and secreted in equilibrium via the lymphatic drainage system. This circulatory system can cope with a substantial increase in fluid production; however, disruption of this balance can lead to fluid accumulation and an associated pleural effusion, which may be further exacerbated if infection is present. Infection in the lung activates an immune response and stimulates pleural inflammation. Pleural vasculature becomes more permeable and inflammatory cells and bacteria leak into the pleural space causing pleural fluid infection and formation of pus resulting in the classical empyema.<sup>2,4,5</sup>

*Staphylococcus aureus* is the leading cause of empyema in developing countries although *Streptococcus pneumoniae* is the predominant cause of bacterial pneumonia and empyema in developed nations.<sup>6,7</sup> It occurs more frequently in infants and preschool children.<sup>8</sup> Other important causes, which are becoming increasingly frequent in several countries, are methicillin-sensitive *Staphylococcus aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA). Other commonly identified organisms include *S. pyogenes*, *Haemophilus influenzae*, *Mycoplasma pneumoniae*, *Pseudomonas aeruginosa*, and other *Streptococci*. The identification of causative organisms is usually determined by standard blood or pleural fluid cultures. Cultures are limited in that the yield can be as low as 8%, possibly

because of prior antimicrobial drug treatment. Molecular techniques, such as PCR, are more sensitive in detecting causative organisms than standard culture but are not routinely employed in laboratories for clinical use.<sup>2,4,6</sup>

Empyema usually presents with persistent high-grade fever, cough, fast breathing or difficulty in breathing, irritability and sometimes chest deformity. Cough may be absent in the early part of the pneumonic process caused by *Streptococcus pneumoniae* but develops as the disease advances. Chest pain and diarrhoea may be a feature. Malnutrition is frequently associated. The patients may present with several previous consultations and treatment without complete resolution of symptoms after being administered various broad-spectrum antibiotics including empirical anti-tuberculous treatment. Rarely the empyema may be bilateral. The disease can produce significant morbidity in children if inadequately treated.<sup>6,8</sup>

Empyema usually advances in severity in a contiguous fashion which can be divided into three stages namely: exudative, fibrinopurulent and organizing, commonly named as 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> phase according to the American Thoracic Society. Patients can progress to another stage within hours if effective treatment is not provided. The therapy is stage dependent and the evacuation of pus has been considered essential. Additionally, in the third phase the organized, thick fibrous peel in the pleural cavity restricts lung expansion, which causes chronic sepsis and intensifies the respiratory insufficiency. That is called "trapped lung" and requires excision of the pleura to achieve proper lung expansion and ventilation. Treatment ranges from intravenous antibiotics, intercostal chest tube drainage (ICD), video-assisted thoracoscopic surgery (VATS) to thoracotomy decortication (TDC). Early initiation of intravenous antibiotics and ICD procedure promote smooth recovery and lung expansion. The various therapeutic options available include intrapleural instillation of fibrinolytic agents, breaking down of loculations or decortication either by video-assisted thoracoscopic surgery (VATS) or thoracotomy and open drainage.<sup>9</sup> VATS is neither easily available nor affordable by majority of patients in developing countries.<sup>10,11</sup> Intrapleural fibrinolytic therapy is safer and cost-effective option to facilitate drainage of empyema. This prospective observational study is done to evaluate demographic characteristic and various management strategies and outcome in children with empyema thoracis.

## METHODOLOGY

This is a prospective hospital based observational study, conducted at Nobel Medical College Teaching Hospital Biratnagar, from December 2021 to November 2022. Sample size was calculated by using the formula ( $n = Z^2 pq/d^2$ ) where Z equals to 1.96, p equals to 3% and d equals to 0.05. All children in the age group of 1 month to 16 years diagnosed pyogenic empyema by light criteria during the study are included in the study. Children below 1 month of



age and pleural effusion not meeting the criteria for exudative pleural effusion by Light's criteria are excluded from the study. Institutional ethics committee was also sought for conducting the study from the institutional review committee of Nobel medical college and teaching hospital. They are divided according to mode of presentation, duration of illness and side involved in Xray chest. The basic investigation like chest Xray and blood culture were done in all the cases. After collecting, the data were verified and coded accordingly and entered in Microsoft excel 2007 and converted into statistical package for social science (SPSS v.20) for statistical analysis. For the descriptive presentation, frequency and percentage (%) were calculated, and also tabular presentation was made.

## RESULTS

During the study period 25 children were admitted with empyema thoracis. Out of which 52% were male and 48% were female. 68% of the children were in the age group of more than 5years, 24% were in the age of 2-5 years and 8% were in age of less than 2 years.

**Table 1: Demographic characteristics of patients**

Demographic characteristics	Frequency (N=25)	Percentage
Age (years)		
<2	02	08.00
2-5	06	24.00
>5	17	68.00
Gender		
Male	13	52.00
Female	12	48.00

Most common clinical feature was fever followed by cough, chest pain and shortness of breath. Duration of illness was <1week in 48% of the children, 1-2weeks in 40% and >3weeks in 12% of the children. In 80% of the children there was unilateral involvement in the x- ray chest.

**Table 2: Clinical characteristics of patients**

Clinical characteristics	Frequency (N=25)	Percentage
Mode of presentation		
Fever	21	84.00
Cough	02	08.00
Chest pain	01	04.00
Shortness of breath (SOB)	01	04.00
Duration of illness (weeks)		
<1WEEK	12	48%
1-2WEEKS	10	40%
>3WEEKS	3	12%
Chest X-ray		
Unilateral involvement	20	80.00
Bilateral involvement	05	20.00

Culture was positive in 68% out of which 32% was staphylococcus aureus, 20% was Mycobacterium TB, 16% was Streptococcus pneumoniae.

**Table 3: Organisms cultured among patients**

Organisms cultured	Frequency	Percentage
Staphylococcus aureus	08	32.00
Streptococcus pneumoniae	04	16.00
Mycobacterium TB	05	20.00
No growth	08	32.00
<b>Total</b>	<b>25</b>	<b>100.00</b>

In the children who were uncomplicated, all of them had ICD usage, 76.4% had urokinase therapy and 5.8% had undergone thoracotomy and none of them had need for surgery. In the children with complication 87.5% had ICD usage and urokinase therapy, 25% of them had undergone thoracotomy and 12.5% had need for surgery.

**Table 4: Clinical outcome of empyema thoracis among patients**

Disease characteristics	ICD usage	Urokinase therapy	Need for surgery (VATS)	Thoracotomy
Complicated (n=08)	07 (87.5%)	07 (87.5%)	01 (12.5%)	02 (25.0%)
Uncomplicated (n=17)	17 (100.0%)	13 (76.4%)	00 (0.0%)	01 (5.8%)

## DISCUSSION

In empyema thoracis, clinical signs and symptoms in isolation are non-specific, and mimic pulmonary infection of any compartment, with fever and increased white cell count being common findings. In developing countries, more than one-fourth of hospital-admitted patients with pneumonia eventually develop parapneumonic effusion or empyema because of delayed initiation of adequate treatment. The mortality and morbidity due to empyema thoracis may be due to underlying comorbidities or delay in initiation of definitive treatment.<sup>6,8</sup> We have described a clinical presentation and demographics of the children presenting with empyema thoracis at the Department of paediatrics and Neonatology, Nobel Medical College Teaching Hospital, Biratnagar.

In our study males were admitted more commonly than females and most of them were in the age group of more than 5 years which is comparable to a study conducted by Bhatta NK et al<sup>12</sup> and Thakkar PK et al<sup>2</sup>. And Neha Agarwal et al.<sup>6</sup> In most of the studies, male gender was identified as a risk factor of loculated effusion among children. However, until now, the biologically plausible mechanism of gender distribution among patients with pleural disease remains unknown.<sup>2,8,12</sup>

In our study fever, cough, chest pain shortness of breath were the symptoms seen out of which fever was the most common mode of presentation which was similar to the study conducted by Thakkar PK whereas in a study conducted by Yuan-Ming Tsai et al most common presentation was cough followed by chest pain. This difference may be due to the small sample size of our study and wide variation in symptoms according to the timing of presentation and causative organisms.<sup>2,13</sup>

In our study duration of illness was less than 1 week in 48% of the children, 1-2weeks in 40% and more than 3weeks in



12% of the children which is comparable to a study conducted by Neha Agarwal et al. Theoretically, the duration of illness may vary on the initial demographic profile of the patients; depending on the clinical features, laboratory findings and initial radiographic pictures.<sup>5</sup>

In our study majority of the culture positive cases (32%) showed growth of staphylococcus aureus followed by mycobacterium tuberculosis and streptococcus pneumoniae which is similar to a study conducted by Yuan-Ming Tsai et al, Bhatta NK et al, Thakkar PK and Neha Agarwal et al.<sup>2,6,13</sup> Wide variation in organisms may occur due to the mandatory vaccination policy or the availability of vaccine, with other issues such as malnutrition and low social-economic status. Early diagnosis by early identification of causative microorganisms by culture, would guide for the early initiation of the targeted antimicrobial therapy and improve the outcome of the children.<sup>9</sup>

In our study 80% of the children had unilateral involvement in x-ray chest and only 20% had bilateral involvement which was similar to a study conducted by Neha Agarwal et al.<sup>6</sup> X-ray findings may vary according to the stage of the disease, organisms causing the disease and course of treatment.<sup>8</sup>

In our study only one child who had complications had undergone VATS and none of the children without any complications underwent VATS, whereas in a study conducted by Yuan-Ming Tsai et al almost of the children underwent VATS.<sup>13</sup> In a study conducted by Thakkar PK et al majority of the children were managed with ICD and only 38% are managed with VATS which is comparable to our study.<sup>2</sup> In a meta-analysis conducted by Avansino et al it was suggested that primary operative therapy of empyema is

associated with lower mortality rate and morbidity compared to conservative management.<sup>14</sup>

## CONCLUSIONS

Empyema thoracis is the disease commonly seen in the young children. Most of the children were in the age group of >5 years and majority were males. Fever was the most common mode of presentation followed by cough. Duration of the illness was less than 1 week in most of the children with unilateral involvement was more common in the chest X-ray. Most commonly cultured organism was Staphylococcus aureus and the most of the children were managed with ICD usage in our study.

## LIMITATION OF THE STUDY

The sample size was limited to draw conclusions and CT scan of the chest was not done due to financial constraints.

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## CONFLICTS OF INTERESTS

Authors declare that they have no conflict of interests.

## FINANCIAL DISCLOSURE

We did not receive any financial support for the study.

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