

Clinico-epidemiological profile and outcome of pleural effusion of infective etiology in children from central India



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ABSTRACT

Background: Empyema thoracis is an accumulation of pus in the pleural space. It is estimated that 0.6% of childhood pneumonias progress to empyema, affecting 3.3/1,00,000 children. Various treatment options available include antibiotics alone or with chest tube drainage, intrapleural fibrinolytics, video-assisted thoracoscopic surgery, and open decortications. **Aims and Objectives:** (1) The objective of the study was to study clinico-epidemiological and lab profile of pediatric patients with pleural effusion of infective etiology and (2) to study outcome and short term follow-up. **Materials and Methods:** Prospective observational study conducted from June 2020 to May 2021 at the pediatric department of a tertiary care hospital, central India. Inclusion criteria: Children between 6 months and 14 years diagnosed with pleural effusion clinically and radiologically. Exclusion criteria: Effusion of traumatic or malignant origin. Detailed history, examination, and relevant investigations were recorded. Data were compiled and analyzed. Patients were treated with intercostal drainage, antibiotics and were referred for surgical intervention wherever necessary. **Results:** Thirty-five patients were included in this study. The mean age of the patients was 4.4 years. Fever (100%), cough (88.5%) and breathlessness (65.7%) were the most common symptoms found at admission. *Staphylococcus aureus* was the most common organism isolated from pleural fluid. In the present study, 77% (27) patients were treated with ICD and antibiotics, 11.5% patients required surgical intervention, and 11.5% patients responded to antibiotics alone. The mortality rate in our study was 5.7% and the rest of the patients were successfully discharged and followed up. **Conclusion:** Antibiotics and tube thoracostomy are effective methods of treating pyogenic empyema thoracis in children in resource poor settings.

Key words: Child; Empyema; Pleural effusion; *Staphylococcus aureus*; Tubercular

INTRODUCTION

Hippocrates in 600 B.C. defined empyema thoracis as a collection of pus in the pleural cavity and advocated open drainage as its treatment.¹ Acute respiratory infections are the most common illness of childhood accounting for 50% of all illness in under-fives and 30% in the 5–12 years age groups, largely involving the upper respiratory. However, about 5% involve the lower respiratory tract resulting in serious diseases, especially bacterial pneumonia.² About 40% of bacterial pneumonia are said to be complicated by

parapneumonic effusions, 10% of which will evolve into empyema.³ Although the incidence of empyema thoracis has declined in the west, it still remains a public health problem in developing countries due to low socioeconomic status, overcrowding, malnutrition, delay in diagnosis of pneumonia, and late referral to higher center. Malnourished children are predisposed to recurrent, severe, and complicated infections. We conducted this observational study to delineate the clinico-bacteriological profile of parapneumonic effusion and its outcome with different modes of management.

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Aims and objectives

- 1) To study clinico-epidemiological and laboratory profile of pediatric patients admitted with pleural effusion of infective etiology.
- 2) To study their outcome and short term follow up.

MATERIALS AND METHODS

This prospective, observational study was done at a tertiary care hospital in central India. The study was conducted over a period of 12 months (June 2020 - May 2021) after clearance from the Institutional Ethics Committee.

Inclusion criteria

Patients between age 6 months and 14 years diagnosed as pleural effusion clinically and radiologically during study period were included in the study.

Exclusion criteria

The following criteria were excluded from the study:

1. All patients with malignant or traumatic pleural effusion or with prior surgical intervention
2. All patients with pleural effusion secondary to CCF, Nephrotic syndrome, Dengue fever, etc.

After history taking and clinical examination, relevant investigations such as chest X-ray, ultrasound (USG) chest, and pleural fluid analysis including culture and sensitivity were done. Depending on the above results patients were either treated with antibiotics alone or antibiotic and intercostal drainage. Patients were referred for surgical intervention wherever necessary.

RESULTS

In this study, a total of 35 cases were enrolled out of which 54.2% (n=19) were males and 45.7% (n=16) were females. The mean age was 4.4 years. As per the analysis, the incidence of parapneumonic effusion was more common in the age group of 6 months - 5 years (n=23) and 34.2% (n=12) cases were in the age group 6–14 years. Fever (100%), cough (88.5%), and breathlessness (65.7%) were the most common symptoms found at admission (Table 1).

The mean duration of symptoms before admission in present study was 22 days (5–90 days). Chest X-ray was performed in all patients and showed pleural effusion. In the present study, right sided empyema was more common (62.2%) cases. In the present study, USG chest was done in all the patients and 11% patients had minimal effusion, 40.5% had moderate effusion, and 48.5% had gross effusion. Mean hemoglobin (Hb) of the patients enrolled in our study was 8.6 g/dL with 27% of the patients having

severe anemia (Hb <7 g/dL). About 60% of our cases had leukocytosis (total leukocyte count [TLC] >10,000). In the current study, the average pleural fluid cell count was 10,080 cells/mm³ (100–25,000) with lymphocyte predominance (63%). Yield of pleural fluid culture in our study was 26%. The most common organism being isolated was *Staphylococcus aureus* in 88.8%. One case was positive for *Pseudomonas* (Table 2).

In our study, blood culture was positive in 28.5% cases with eight blood cultures positive for *S. aureus*, one for *Pseudomonas*, and one for *Acinetobacter* (Table 3).

Of the ten patients having tubercular effusion the diagnosis of tuberculous (TB) was established on microbiological confirmation by Cartridge based nucleic acid amplification test (CBNAAT), of either sputum or pleural fluid, in 50% (five cases) patients. In the remaining patients, this diagnosis was based on clinical grounds, that is, strong history of TB contact, Mantoux test positive, pleural fluid cytology, and radiological appearances consistent with active tuberculosis. In the present study, 77% (n=27) patients were treated with ICD and antibiotics alone, 11.5% (n=4) patients required surgical intervention, and 11.5% (n=4) patients responded to antibiotics alone and did not require drainage of the effusion due to the small size. Two patients needed both intercostal drainage and decortication and two patients were treated by video-assisted thoracoscopic surgery (VATS).

Table 1: Clinical presentation of cases with pleural effusion

Symptoms	No. of cases	Percentage
Fever	35	100
Cough	31	88.5
Tachypnea	27	77.1
Breathlessness	23	65.7
Chest pain	13	37.1
Hypoxia	12	34.2

Table 2: Organism isolated from pleural fluid culture

Type of organism	No. of cases	Percentage
<i>Staphylococcus aureus</i>	8	22.8
<i>Pseudomonas</i>	1	2.8
No growth	26	74.2

Table 3: Blood culture profile of patients with pleural effusion

Type of organism	No. of cases	Percentage
<i>Staphylococcus aureus</i>	8	22.8
<i>Pseudomonas</i>	1	2.8
<i>Acinetobacter</i>	1	2.8
No growth	25	71.4

The most common first-line antibiotic started in our study was intravenous ceftriaxone and intravenous vancomycin. The mean duration of intravenous antibiotic in our study was 14 days. Later oral antibiotics were given for 2–4 weeks at the time of discharge. The median duration of chest tube drainage in our study was 7 days and the mean duration of hospital stay was 19 days. The mortality rate in our study was 5.7%. All the patients discharged were followed up after 1st week, 3rd week, 6th week and if available at 3 months. About 48% patients came for 1st follow-up, 32% patients at 3rd week follow-up, and only 16% of the patients at 6th week follow-up. Most common symptom at 1st week follow-up was cough in 33% patients and pain at the ICD site in 25% patients which eventually resolved at further outpatient department (OPD) visits.

DISCUSSION

Out of the total cases, 54.2% (n=19) were males and 45.7% (n=16) were females. The male: female was about 1:1. About 2/3rd of the patients in the present study were younger than 5 years and 1/3rd cases were in the age group 6–14 years which is consistent with other previous studies. In a study by Baranwal et al., and Agarwal et al., 66.5% and 79.9 % of the cases, respectively, were below the age of 5 years.^{4,5} In the present study, mean age of patients at presentation was 4.4 years which was similar to the study conducted by Das et al., (mean age=4.74 years).⁶

In our study, 62.8% cases were undernourished, similar to studies conducted by Baranwal et al., (62%) and Agarwal et al., (64.6%).^{4,5} Pneumonia is common in malnourished children and frequently associated with fatal outcomes.^{7,8} A systematic review has reported higher mortality in children with pneumonia with severe malnutrition than moderate malnutrition.⁹

Fever (100%), cough (88.5%), and breathlessness (65.7%) were the most common symptoms found at admission similar to other studies. Kumar et al., reported 90% cases with fever, cough and breathlessness.¹⁰ Das et al., reports similar symptomatology with fever in 96.7% cases, cough in 90%, and breathing difficulty in 66.7%.⁶ The mean duration of symptoms before admission in present study was 24 days (5–90 days). As per the study by Das et al., this duration was 11.5 days.⁶ This difference could be due to higher patients with tubercular effusion in our study which were excluded from the study of Das et al.

Chest X-ray was performed in all patients and showed pleural effusion. In the present study, right sided empyema was more common (62.2%) cases. Similar findings were observed in Rao et al., (62.5%).¹¹ Anatomically right sided

bronchus is more in line with trachea than that of the left side. Hence, lung infections are more common on the right side and empyema is also common on the right side.⁶

In the present study, USG chest was done in all the patients and 11% patients had minimal effusion, 40.5% had moderate effusion, and 48.5% had gross effusion. Septated effusion was present in 11.1% cases. Rao et al., found gross pleural effusion in 41.6% cases.¹¹ About 77% of the total enrolled patients had underlying consolidation. Similar results were also found by Agarwal et al., (60%)⁵ implying that most cases occurred as a complication of bacterial pneumonia.

Mean Hb of the patients enrolled in our study was 8.6 g/dL with 27% of the patients having severe anemia (Hb <7 g/dL). About 60% of the cases in our study had leukocytosis (TLC >10,000) versus 32% cases in the study by Mehta et al. This difference in TLC count could be because Mehta et al., study included transudative causes of pleural effusion in addition to parapneumonic effusion.¹²

In the current study, the average pleural fluid cell count was 10,080 cells/mm³ (100–25,000) with lymphocyte predominance (74%). In a 15-year long single-center cohort study conducted at University Children's Hospital Zurich of parapneumonic effusion polymorphonuclear cells were found predominantly.¹³ This could be explained by the fact that our study had a large number of patients having tubercular effusion. High lymphocyte predominance in exudative effusions favors tubercular etiology.⁶

Yield of pleural fluid culture in our study was 26% with the most common organism being isolated was *S. aureus* in 88.8%. One case was positive for *Pseudomonas*. This low yield of culture could be due to prior use of antibiotics and late referral. Another reason for this low yield could be the lack of use of molecular methods for diagnosis, which greatly enhances the chances of detection of the etiological agents, even in previously treated patients.¹⁴ Similar results were found by Rao et al., culture was positive in 37.5% with *S. aureus* was the major organism that was isolated in 16.6%.¹¹

In our study, blood culture was positive in 28.5% cases with eight blood cultures positive for *S. aureus*, one for *Pseudomonas*, and one for *Acinetobacter*. The rate of isolation was higher as compared to other studies. In the study done by Kumar et al., only one blood culture was positive out of 25 cases¹⁰ and Baranwal et al., had 5% blood cultures positive.⁴

Out of 35 cases in our study one patient also presented with pericardial effusion, culture of which was positive for

Escherichia coli but no organism could be isolated from either pleural fluid or blood in that patient. Of the ten patients having tubercular effusion the sensitivity of CBNAAT for picking up diagnosis was 50% and in rest this diagnosis was established on clinico-radiological basis. CBNAAT detects MTB genetic material and has a sensitivity ranging from 28% to 81% for pleural fluid.¹⁵

In the present study, 77% (n=27) patients were treated with ICD and antibiotics, 11.5% (n=4) patients required surgical intervention, and 11.5% (n=4) patients responded to antibiotics alone and did not require drainage of the effusion due to the small size. In the study done by Baranwal et al., the success rate of medical management over surgery was 79% which is similar to our finding.⁴ In our study, two patients needed both intercostal drainage and decortication. They had presented after 15 days and had thick septations with organized empyema on computed tomography (CT) scan and died in the post-operative period; two patients were treated by VATS.

Surgery is needed in persistent sepsis and pleural collection despite ICD and antibiotics. VATS, mini-thoracotomy, and decortication are available options. The evidence-based criteria to guide the decision on when a child should proceed to surgery is lacking and consequently there is little consensus on the role of medical versus surgical management or early versus late surgery.¹⁶

A meta-analysis comparing operative and non-operative procedures has also concluded that conservative management leads to recovery in more than 76% of the patients. However, the study demonstrated that a less invasive primary operative procedure like VATS has the potential to interrupt the progression of empyema, decrease the pain and discomfort associated with prolonged thoracostomy tube usage and reduce the total duration of hospital stay.¹⁷

The mortality rate in our study was 5.7% which was similar to other studies; Tiryaki et al., (5%)¹⁸ and Agarwal et al., (7.8%).⁵ The British Thoracic Society (BTS) recommends that all patients with significant pleural infection should be treated with antibiotics and drainage of the pleural fluid.¹⁶ The most common first-line antibiotic started in our study was intravenous ceftriaxone and intravenous vancomycin. Information on optimal duration of parenteral therapy is lacking. In a 10-year study done at PGIMER, Chandigarh, India antibiotics were administered orally after patients became afebrile, respiratory distress subsided, and significant loculations were ruled out, usually after 7–14 days.⁴ The BTS also recommends intrapleural fibrinolytics in complicated parapneumonic effusion or

empyema.¹⁶ However, a multicentric randomized double blinded study reported that there was no benefit from streptokinase in terms of mortality, rate of surgery, radiographic outcomes, or duration of hospital stay.¹⁹ As this facility was not available in our hospital none of our patients received this modality of treatment.

The median duration of chest tube drainage in our study was 7 days consistent with the previous studies Kumar et al. (8 days),¹⁰ Agarwal et al. (8 days),⁵ and Rao et al. (11 days).¹¹ The mean duration of hospital stay in our study was 19 days. Similar results were also found in other studies Das et al. (16 days).⁶ All the patients discharged were followed up after 1st week, 3rd week, and 6th week and if available at 3 months. About 48% patients came for 1st follow-up, 32% patients at 3rd week follow-up and only 16% of the patients at 6th week follow-up. Most common symptom at 1st week follow-up was cough in 33% patients and pain at the ICD site in 25% patient which eventually resolved at further OPD visits. A prospective observational study on the long-term follow-up of pediatric pleural empyema demonstrates that although a large proportion of children continued to exhibit signs and symptoms of pleural empyema in the month following discharge from hospital, in most cases, resolution occurred within 12 months.²⁰

Limitations of the study

The sample size was limited to make comparisons and to draw conclusions for the general population. Study was conducted in a tertiary hospital where cases referred from other hospitals mostly with complications, so this population is not representative of general population. CT scan of the chest was not done in all the cases due to financial constraint as most of the patient's belonged to lower socioeconomic class.

CONCLUSION

Empyema in children causes significant morbidity which can be reduced by prompt and adequate treatment of bacterial pneumonia. The present study highlights the predominance of *S. aureus* as an etiological agent. It also highlights that antibiotics and tube thoracostomy are effective methods of treating pyogenic empyema thoracis in children in resource poor settings. Patients presenting later in the clinical course and not responding to conservative management should be referred earlier for surgery.

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Authors' Contributions:

RJ- Concept and design of the study, prepared the first draft of manuscript; **AB-** Interpreted the results and reviewed the manuscript preparation; **DC-** Preparation and revision of manuscript.

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