



Empyema Thoracis in children: A Five-Year Analysis from a Tertiary Care Center in Eastern Nepal

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Abstract

Introduction: Complicated community-acquired pneumonia resulting in empyema thoracis remains the largest single cause of morbidity and mortality worldwide in children. This study was carried out to evaluate the clinical profile, associated complications and outcome of empyema thoracis in children.

Methods: A retrospective study was conducted in the Department of Paediatrics at a tertiary care center in Eastern Nepal. A total of 106 children were managed with the diagnosis of complicated pneumonia with effusion or empyema thoracis from March 2017 to February 2021 (Five years). Only those patients who had clinico-radiological evidence of pleural effusion or empyema thoracis and received treatment with or without intercostal chest tube drainage (ICD) as the initial procedure were enrolled in the study. Besides supportive treatments and antibiotics; streptokinase was instilled intrapleurally in all the patients for three days. Patients who did not respond underwent VATS / decortication.

Results: Majority of the children (60.19%) were below five years of age and were males (73.58%). Majority (55.67%) had a right-sided pleural effusion and fever was the predominant symptom (55.66%) at presentation. The pleural fluid culture was sterile in more than half (55.66%) of the patients with *Staphylococcus aureus* grown in 33.96%. The three most common complications were subcutaneous emphysema, thickened pleura, and pyo-pneumothorax. The success rate of medical management was 83.96% and the mortality was low (2.84%).

Conclusions: The success rate of conservative management with antimicrobial therapy, intercostal drainage and fibrinolytics in this study was high (83.96%) with no major adverse effects of fibrinolytic therapy in empyema thoracis.

Introduction

Complicated community-acquired pneumonia (CCAP) resulting in empyema thoracis remains the largest single cause of morbidity and mortality worldwide in children.^{1,2} Empyema is defined as the presence of pus in the pleural space. A sterile pleural effusion associated with pneumonia with few or no inflammatory cells is termed para-pneumonic effusion (PPE).³ Empyema develops as a complication of bacterial pneumonia in 0.6 - 3% of hospital admissions but small pleural effusions may be present in up to 40% of bacterial pneumonia.^{4,5} Though most patients fully recover, CCAP is characterized by severe illness, prolonged hospitalization, and a protracted disease

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course. Other serious common systemic complications include sepsis and septic shock, metastatic infection, multiorgan failure, acute respiratory distress syndrome, disseminated intravascular coagulation and death.^{2,4,5}

The incidence and hospitalization following CCAP have decreased globally with the use of the 13-valent pneumococcal vaccine PCV (PCV13).⁶⁻¹⁰ There is still a high burden of CCAP in our region; possible reasons for persisting high incidence of CCAP in Nepal could be due to the use of the 10-valent pneumococcal vaccine (PCV-10), poverty, ignorance, malnutrition, misdiagnosis, delay in initiating treatment, or inadequate / inappropriate treatment of bacterial pneumonia, and delayed referral.¹¹ *Staphylococcus aureus* is the leading cause of empyema in developing countries.¹²⁻¹⁴

The increasing incidence of empyema thoracis despite high coverage of pneumococcal vaccine, significant morbidity with frequent complications, and requirement of prolonged hospitalization in children have motivated pursuing this study. This retrospective study was carried out to evaluate the clinical profile, associated complications, and outcome of empyema in children.

Methods

A retrospective study was conducted in the Department of Paediatrics and Adolescent Medicine at B.P. Koirala Institute of Health Sciences, Dharan, Nepal. A total of 106 children were managed in the department with the diagnosis of complicated pneumonia with effusion or empyema thoracis from March 2017 to February 2021 (Five years). During the patient management, expert opinion following evaluation of the patient and intervention was provided by the Department of CTVS whenever it was required. Possible patients were identified by searching the records in admission - discharge books of the paediatric wards which were cross-checked and verified on the databases of record section to identify children under 15 years of age, admitted in the Department of Paediatrics and Adolescent Medicine for at least 24 hours and who had a diagnosis of empyema or complicated pneumonia with effusion (International Classification of Diseases Clinical Modification - ICD-10 code J86 (Empyema) / J18.9 (Complicated pneumonia). The health record for each possible patient was reviewed and included in the study if they had clinico-radiological evidence of pleural effusion or empyema thoracis and received treatment with or without intercostal chest tube drainage (ICD) as the initial procedure. Children with empyema secondary to chest trauma, thoracic surgery, or esophageal rupture were excluded. A case record form consisting of demographic, clinical, diagnostic, treatment, and outcome features of all cases was filled. Death within the hospital during the admission period was also noted.

All case records were evaluated by analyzing detailed history, examination findings and laboratory investigations including imaging findings which were recorded in the case sheet. Investigation findings, chest X-Ray, ultrasonography and computed

tomography (CT scan) of the chest, echocardiography (to detect pericardial effusion) were recorded. The findings of pleural fluid analysis including Gram stain, culture and sensitivity were also recorded for each subject. Complications such as pneumothorax and bronchopleural fistula, prolonged hospitalization were also recorded.

As per the hospital protocol, combination of intravenous cloxacillin and ceftriaxone was used as the first-line antibiotics. Antibiotics were revised based on the clinical response and / or sensitivity report. Closed ICD was done on both sides for bilateral empyema. The tube was usually inserted on the day of admission. Besides supportive treatment and antibiotics, streptokinase was instilled intrapleurally in accordance with the standard practices. Six patients did not receive fibrinolytic therapy because of having bronchopleural fistula at admission. Chest tube manipulation was done whenever required for effective drainage. Response to treatment was noted in the form of reduction in respiratory distress, better air entry and improvement on X-ray and USG findings. Antibiotics were given for a total duration of four to six weeks or longer (Depending upon the clinical course). The intercostal drain was clamped and removed as per the standard guidelines and practices. For patients who did not respond to medical management, a CT scan of the chest was done and an expert opinion was taken from the cardiothoracic surgeon. The patient was referred to the cardiothoracic surgeon for VATS / decortication if needed. All the data regarding clinical characteristics (Median duration of chest tube drainage / hospital stay), and clinical outcome (in terms of resolution / need for surgery / mortality) were analyzed to descriptive statistics like mean, median, and percentages.

Results

Of the 106 children with complicated pneumonia, majority were malnourished.

Table 1. Clinical and pathological spectrum of empyema thoracis in children (N = 106)

Parameters	Sub-parameters	Number of cases (%)
Age < 2 years (18)	Male	11 (10.27)
	Female	7 (6.60)
Age 2 - 5 years (46)	Male	34 (32.00)
	Female	12 (11.32)
Age 5 - 15 years (42)	Male	33 (31.32)
	Female	9 (8.49)
Primary presenting complains	Fever	59 (55.66)
	Tachypnoea	29 (27.35)
	Tachypnoea with chest pain	18 (16.99)

BMI (percentile)	< 5 th	71 (66.98)
	85 th - 95 th	35 (33.02)
Median duration of Fever at presentation	13 days (range 7 - 23 days)	
	No	5 (4.73)
Prior use of antibiotics	Yes (Only oral)	37 (34.90)
	Yes (Oral followed by IV)	64 (60.37)
	Left	42 (39.62)
Site of involvement (X-ray)	Right	59 (55.67)
	Bilateral	5 (4.71)
	Underlying consolidation with minimal fluid	16 (15.09)
USG chest (At presentation)	Consolidation with thick fluid and septations	58 (54.71)
	Thickened pleura with thick fluid	32 (30.20)
	Yes	91 (85.85)
Requirement of ICD	No	15 (14.15)
	< 7	56 (61.54)
Duration of ICD (days)	> 7	35 (38.46)
	Purulent	61 (57.54)
Pleural fluid color	Straw	25 (23.58)
	reddish	20 (18.88)

BMI: body mass index (kg / m²), USG: ultra-sonography
ICD: Intercostal drainage

Of the children evaluated, 18 (16.87%) were below two years of age, 46 (43.32%) were between three and five years, and 42 (39.81%) were above five years of age. In this study, majority were males (78, 73.58%) and five (4.71%) patients were suffering from bilateral pleural effusion. In the majority, fever was the predominant symptom at presentation (55.66%) and on ultrasonography (USG) of the chest, majority had (54.71%) thick purulent fluid with septations. ICD was done in 85.85% of patients and the majority (61.54%) had ICD placement for < seven days. [Table 1]

Table 2. Organisms cultured from pleural fluid

N = 106

Organisms	Frequency	Percentage
Staphylococcus aureus	36	33.96
Streptococcus pneumoniae	5	4.72
Pseudomonas	3	2.83
Mycobacterium tuberculosis	3	2.83
NO growth	59	55.66

One-third had Staphylococcus aureus in pleural fluid culture. The pleural fluid culture was sterile in more than half (55.66%) of the patients. Five patients had Streptococcus pneumoniae, three had

Pseudomonas, and three had Mycobacterium tuberculosis in the pleural fluid culture. [Table 2]

Table 3. Complications associated with empyema. N = 106

Complications	No. of patients	Percentage (%)
Subcutaneous emphysema	34	32.07
Thickened pleura	31	29.24
Pyo-pneumothorax	30	28.31
Pneumothorax	18	16.98
Accidental removal of ICD tube	14	13.20
Pyo-pericardium	8	7.54
Bronchopleural fistula (total)	8	7.54
Bronchopleural fistula (at admission)	6	5.67
Mortality (sepsis)	3	2.83
Septic arthritis/ osteomyelitis	3	2.83
Patients requiring second line antibiotics	39	36.79%

ICD: Intercostal drainage

The three most common complications were subcutaneous emphysema, thickened pleura, pyo-pneumothorax; each being present in about one-third of the patients. [Table 3]

Table 4. Clinical outcome of empyema thoracis in study population (N = 106).

Disease characteristics	No. of patients (%)	Median duration of ICD drainage (days)	Resolution (%)	Need for surgery	Mortality
Duration of illness ≤ 14 days	15 (14.15)	Not required	15 (100)	0	0
Duration of illness ≤ 14 days	54 (50.94)	10 (7-18)	47 (87.03)	6 - vats	1
Duration of illness > 14 days	29 (27.35)	16 (8-25)	24 (82.75)	2 - decortication 2 - vats	1
Broncho-pleural fistula	8 (6 at admission)	28 (20-45)	3 (37.5)	4 - followed CTVS department	1
Total	106		89 (83.96)	14 (13.20)	3 (2.84)

ICD: Intercostal drainage, VATS: Video-assisted thoracoscopic surgery

Nearly, 15% of patients did not require ICD. The success rate of medical management in patients who received intrapleural fibrinolytic therapy (Streptokinase) with ICD within 14 days of symptom onset was 87.03% while it was 82.75% in patients who received intrapleural streptokinase after 14 days of onset of symptoms. Out of 106 children, three (2.84%) patients died during the treatment in the hospital. Eight patients developed broncho-pleural fistula. Out of these, six had broncho-pleural fistula at the time of admission. Of these, two recovered during the hospital stay, and four were asked to follow up in the CTVS OPD at the time of discharge. The overall success rate of medical management for empyema was 83.96%. [Table 4]

Discussion

In this retrospective study of empyema thoracis in children, good pulmonary outcome was noted with conservative therapy alone. Higher incidence of empyema was noted in males (73.58%), in children under five years of age (60.19%), and undernourished children (66.98%). The findings of this study are similar to other previous studies.¹⁵⁻¹⁸ Fever was the most common symptom at presentation. Underlying consolidation was noted in 69.80% of patients with empyema, implying that most cases occurred as a consequence of bacterial pneumonia. Cham CW et al also noted that the commonest cause of empyema was post-pneumonic.¹⁹ The commonest organism isolated on the pleural fluid culture was *Staphylococcus aureus* in 33.96% cases while the majority (55.66%) had pleural fluid sterile which might be due to previous use of antibiotics. Of the patients enrolled in this study, 60.37% of patients had prior use of intravenous antibiotics. This finding is similar to the other studies.^{20,21} But, in the study done by Eastham et al, the commonest organism isolated was *Streptococcus pneumoniae*.²² In our study *Streptococcus pneumoniae* was present in only five patients.

Most of the times, referral of the patient to the tertiary care hospital was late after several days of symptoms and the majority had received suboptimum or inappropriate treatment. In this study, the median duration of symptoms or fever before admission was 13 days (Range 7- 23 days). As many as 10 patients were referred after three weeks of intravenous therapy and were inappropriately started on antituberculosis treatment (ATT) and four had developed empyema necessitans due to non-evacuation of pus. Of the late referrals (> two weeks of symptoms); 20 had stage III (organized) empyema at admission. The incidence of complications seen in our study is comparable to other studies.^{11,18} Though, many patients 32 (30.20%) arrived late and had organized empyema with thickened pleura, most 89 (83.96%) were successfully managed with intercostal tube drainage and antibiotics with / without fibrinolytic therapy. Nearly 84% patients with empyema showed complete clinical and radiological resolution with re-expansion of the lung without the need for surgical intervention like VATS. The success rate of conservative management was 83.96%. The reasons for delayed presentation might be due to the difficult topographical locations; sometimes taking two or more days to reach the tertiary care center or due to the poor socioeconomic status of the parents as evidenced by the low nutritional status of the patients. Similar to this study, Satpathy et al noted a higher success rate of 90.5% with conservative management of empyema thoracis in children.²³ The success rate of medical management over surgery was 79% in the study done by Baranwal et al which is lesser than in this study.²¹ These differences can be because of delayed presentation of empyema thoracis in our institute and the majority of them being undernourished. Many studies have emphasized that most children with loculated empyema can be treated with antibiotics and chest tube drainage and surgery is required only in few cases only.^{24,25} Whereas, the meta-analysis conducted by Avansino JR et al noted that primary operative therapy of empyema is associated with lower mortality rate and

morbidity as compared to conservative management.²⁶

Only 10 patients needed both intercostal drainage and surgical management (Eight - VATS and two - decortication) in this study. While reviewing the case record of the patients who underwent surgical intervention, it was noted that they presented late; 20 days after onset of symptoms, and had thick septations with organized empyema on the CT scan. Of the eight patients with bronchopleural fistula, six at admission and two during the hospital stay. Four improved with the conservative management whereas, the remaining four were following in the CTVS department, the details of which couldn't be traced. The mortality rate in this study was lower (2.84%) than that noted by other similar studies (3.3% - 10%).¹⁸⁻²⁰ The main limitation of this study is the nonavailability of follow-up records of clinical and radiological improvements of the discharged patients. This is because we do not have the provision of medical recording for the patients following in the OPD after discharge.

Conclusions

Though empyema in children carries very little mortality as compared to adults, it causes a lot of morbidity and complications if not managed properly on time. The success rate of conservative management in this study was 83.96%. No major adverse effects of fibrinolytic therapy were noticed which necessitated discontinuation of it. We also noted that the mortality was low in this study and the main reason for mortality was sepsis following the late presentation.

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