

Original Research Article

Clinical profile, complications, morbidity and outcome of empyema thoracis in children in a tertiary care centre

Neha Agarwal*, Sunil Taneja, Rachit Saxena, Ashish Verma

Department of Pediatrics, G.S.V.M Medical College Kanpur, Uttar Pradesh, India

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*Correspondence:

Dr. Neha Agarwal,

E-mail: drnehaagarwal@gmail.com

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ABSTRACT

Background: Empyema thoracis, an accumulation of pus in pleural space, occurs in 5-10% of children with bacterial pneumonia. Often cases are referred to the tertiary care hospital late resulting in significant complications, morbidity and mortality. Our aim was to study the clinical profile, associated complications, morbidity and treatment outcome of empyema in children.

Methods: A prospective observational study was conducted on 65 children aged 0-12 yrs diagnosed with empyema thoracis admitted in the hospital. After history taking and clinical examination, relevant investigations like chest X-ray, USG chest and pleural fluid analysis including culture and sensitivity were done. All patients were treated with chest tube drainage, antibiotics and intrapleural fibrinolytic therapy.

Results: Maximum patients (61.5%) were seen in age group 1-5 yrs, 18.4% below 1 year, 2 were neonates. Pleural fluid culture was positive in 64.6 % of patients. *Staphylococcus aureus* (58.4%) was the most frequent organism isolated from pleural fluid. Pyopneumothorax (36.9%), broncho-pleural fistula (27.6%) and pneumothorax (18.4%) were common complications. Broncho-pleural fistula was present at admission in 14 patients, developed later in 4 patients and healed with conservative management in 12 patients. Majority of the patients (n=51, 78.4%) had complete resolution of empyema thoracis with re-expansion of lung on conservative management alone. The success rate of medical management in patients who received intrapleural fibrinolytic (streptokinase) within 14 days of symptom onset was 93.3% while it was 71.4% in patients who received intrapleural fibrinolytic after 14 days. 5 (7.6%) patients died, 5 required surgical intervention (decortication/VATS), 4 patients with broncho-pleural fistula not improving on conservative management were referred to higher centre and were lost to follow-up.

Conclusions: Empyema in children causes significant morbidity which can be reduced by prompt and adequate treatment of bacterial pneumonia. Antibiotics, chest tube drainage along with intrapleural fibrinolytic therapy is a safe and effective method to facilitate drainage and resolution of empyema even in cases with delayed presentation in resource poor settings and can reduce the need for surgery.

Keywords: Chest tube drainage, Empyema thoracis, Fibrinolytic, Morbidity, Outcome

INTRODUCTION

Empyema thoracis, the presence of pus in the pleural space develops as a complication of bacterial pneumonia in 5-10% of children.¹ The incidence of empyema is increasing despite the advent of potent antimicrobial

agents resulting in significant childhood morbidity.^{2,3} 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.⁴

Staph. 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. It occurs more frequently in infants and preschool children.⁵

The progression in empyema is divided into three stages: exudative stage (1-3 days), fibrinopurulent stage (4 to 14 days) and organizational stage (after 14 days).¹ To start with, parapneumonic effusion consists of clear free-flowing sterile fluid which resolves completely with antibiotics alone (exudative stage). In case of inappropriate or delayed treatment, due to increased fibrin production, the fluid becomes more viscous with development of loculations and in presence of continued uncontrolled infection and non-drainage of pleural space, frank empyema with thick loculations develops leading to formation of a thick non-elastic fibrous peel which prevents the expansion of the lung.^{1,6}

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. VATS is neither easily available nor affordable by majority of patients in developing countries.⁶ Intrapleural fibrinolytic therapy is safer and cost-effective option to facilitate drainage of empyema.

The increasing incidence, significant morbidity, complications such as pneumothorax and bronchopleural fistula, prolonged hospitalization and lack of consensus on the optimal management of empyema in children has generated renewed interest in the subject. There have been very few studies on the effect of fibrinolytic agents on the clinical outcome of empyema.⁷⁻⁹ This prospective study was done to evaluate the clinical profile, associated complications and outcome of empyema in children (resolution/mortality/need for surgery) using antibiotics, effective chest tube drainage and fibrinolytics.

METHODS

A prospective study was done on 65 children aged 0 to 12 years diagnosed with empyema thoracis admitted in our tertiary care hospital over a period of 12 months between October 2016 to September 2017. Patients with prior chest tube drainage before admission, significant comorbidities, post traumatic and tuberculous empyema were excluded from the study. Empyema thoracis was diagnosed by clinical and radiological examination, and aspiration of pus from the pleural cavity. All cases were studied by taking a detailed history and examination which was recorded in a semi-structured proforma. CBC, routine investigations, chest X-Ray and if required ultrasonography and CT scan of the chest, echocardiography (to detect pericardial effusion) was done. Diagnostic thoracentesis and pleural fluid analysis was done including Gram Stain, culture and sensitivity. Intercostal drainage by tube thoracostomy was done in all

patients in fifth intercostal space in midaxillary line with maintenance of under-water seal.

Besides supportive treatment, injectable first line antibiotics were empirically administered as per our institution protocol (amoxicillin-clavulanate). Streptokinase was instilled intrapleurally in all patients on the first day at a dose of 15,000U/kg in 50ml of 0.5% saline daily through the chest tube over 1 hr. After instillation, the tube was clamped for 4 hrs and then free drainage was allowed. This was done daily for three successive days and repeat course given if required. Fourteen patients were not given fibrinolytics (including those with sensitivity to streptokinase or any contraindication to thrombolytic therapy such as abnormal coagulation profile, low platelet count or having bronchopleural fistula at admission)

The chest tube was manipulated whenever required for effective drainage. Clinical response was assessed, and the amount of drainage/colour/bubbling and column movement was recorded daily. Response to treatment was defined as reduction of respiratory distress, better air entry and improvement of X-ray and USG finding. In case of persistence of fever, poor oral intake, continued drainage and raised counts despite initial antibiotic therapy antibiotics were upgraded to vancomycin or as per culture and sensitivity. Antibiotics were given for a total duration of 4 to 6 weeks or longer (depending upon the clinical course).

The intercostal drain was clamped and removed on clinical and radiological improvement (expansion of lung on chest x-Ray) and no or minimal output (<1ml/kg/day) for three consecutive days. In patients requiring prolonged hospital stay who did not respond to conventional antibiotics and tube thoracostomy or developed complication or those not showing radiological signs of lung expansion, CT scan of the chest was done and was referred to cardiothoracic surgeon for VATS/decortication.

Statistical analysis: All the data regarding clinical characteristics of empyema patients, clinical course including complications, morbidity (median duration of chest tube drainage/hospital stay), clinical outcome (in terms of resolution/need for surgery/mortality) was analyzed and subjected to descriptive statistics like mean and percentages.

RESULTS

The clinical profile of patients of empyema is shown in Table 1. During the study period, 65 children were diagnosed as empyema thoracis out of which 43 were males (66.1%) and 22 were females (33.8%). Author divided sixty-five patients into 3 age groups: <1 yr, 1-5 yrs and 6-12 yrs. Commonest age group affected was 1-5 years (61.5%, n=40). In our study, a significant number of empyema cases was seen in children less than 12

months (18.4%, n=12), while 2 cases were below 1 month of age. Only 20% of empyema cases were seen in children above 5 years of age (n=13). 64.6% of children were malnourished. Fever, cough, breathlessness and abdominal distension were the most common presenting symptoms. Median duration of fever was 15 days (5-32 days).

Table 1: Details of the study population/patients of empyema thoracis (n=65).

	No. of patients	Percentage
Age Group		
0-1 year	12 (<1month n=2)	18.4%
1-5 years	40	61.5%
6-12 years	13	20.0%
Sex distribution		
Male	43	66.1%
Female	22	33.8%
No of children with malnutrition	42	64.6%
Median duration of fever	15 days (range 5-40 days)	
Patients requiring second line antibiotics	27	41.5%
Chest X-ray		
Unilateral involvement	62	
Bilateral involvement	3	
USG chest		
Underlying consolidation	39	60%
Thick fluid with septations	46	70.7%
Thickened pleura	21	32.3%

Three patients had bilateral involvement. USG chest at admission showed thick fluid with septations in 70.7% patients, underlying consolidation in 60% patients and pleural thickening in 32.3% patients. Pleural fluid culture grew *Staphylococcus aureus* in 38 children (58.4%), *Streptococcus pneumoniae* in 3, *Pseudomonas* in 1 child while 23 (35.3%) were sterile.

Table 2: Organisms cultured from pleural fluid.

	No. of patients	Percentage
<i>Staphylococcus aureus</i>	38	58.4 %
<i>Streptococcus pneumoniae</i>	3	
<i>Pseudomonas</i>	1	
NO growth	23	35.3 %

Most of the patients showed marked clinical improvement after effective chest tube drainage and antibiotics. Fever and respiratory distress subsided, and oxygen requirement reduced within 5 days of admission. In our study, patients received intrapleural instillation of

fibrinolytic (streptokinase) on first day of admission besides intercostal drainage and antibiotics. Fourteen patients having broncho-pleural fistula were not given streptokinase. The median duration of chest tube drainage was 8 days (5-14 days) in children receiving fibrinolytic before 14 days of symptom onset while it was 14 days (8-25 days) in children who received fibrinolytic after 14 days of illness.

Three patients had moderate pericardial effusion in addition to empyema, but it subsided by itself without the need for drainage. There was accidental displacement of ICD outside pleural cavity in 6 patients requiring reinsertion and 3 patients developed subcutaneous emphysema.

Table 3: Complications associated with empyema.

Complication	No. of patients
Pyopneumothorax	24
Bronchopleural fistula	18 14 (at admission) 4 (developed later)
Pneumothorax	12
Accidental removal of ICD tube	6
Subcutaneous emphysema	3
Bilateral involvement	3
Septic arthritis/ osteomyelitis	3
Pericardial effusion	3
Pyopericardium	2
Empyema necessitans	2
Superior Vena Cava Thrombosis	1
Stroke (MCA territory infarct and aphasia)	1
Thickened Pleura	35
Organisation of empyema	2
Mortality	5 3 (Septic Shock) 1 (Respiratory failure) 1 (Stroke)

41.5% (n=27) children did not show improvement and received second line antibiotics. Out of 27 patients who required prolonged chest tube drainage (2 were neonates one of whom also developed septic arthritis later; 3 patients had bilateral empyema; 2 had pyopericardium in addition to empyema, were referred to cardiothoracic department for pericardiocentesis (1 patient also later developed edema of upper limbs and superior vena cava thrombosis, was started on low molecular weight heparin and given long term oral anticoagulants); 18 had broncho-pleural fistula). Table shows the complications that were observed in patients of empyema thoracis.

Fourteen had bronchopleural fistula at admission while 4 later developed bronchopleural fistula during hospital course. In 8 patients, healing of the fistula occurred with

conservative management though prolonged drainage was required for 3-4 weeks, 2 died while 4 did not improve and were referred to higher centre.

The success rate of medical management in patients who received intrapleural fibrinolytic (streptokinase) within 14 days of symptom onset was 93.3% while it was 71.4% in patients who received intrapleural streptokinase after 14 days.

Out of 65 children of empyema, 5 patients died (mortality rate 7.6%). 1 patient developed MCA territory infarct in left fronto-parietal cortex with aphasia and signs of raised intracranial tension, 3 died due to septic shock and 1

patient had presented with respiratory failure with bilateral involvement.

Fifty one patients out of 65 children studied improved with conservative management alone, 5 required surgical intervention (2 patients presented in stage III empyema (after 40 days of symptom onset), had organised/multiloculated empyema with thick septations on CT scan and were treated by thoracotomy and open decortication, 3 were treated by VATS and referred to cardiothoracic surgery department). Table 4 shows the clinical outcome of the patients of empyema. Pleural thickening was present in majority of patients (68.6%) at discharge.

Table 4: Clinical outcome of empyema thoracis in study population (n =65).

Disease characteristics	No. of patients	Median duration of ICD drainage	Resolution	Need for surgery	Mortality
Duration of illness >14 days	21	14 (8-25days)	15	2 - decortication 2 - vats	2
Duration of illness ≤14 days	30	8 (5-14 days)	28	1 - vats	1
Broncho-pleural fistula	14 (at admission)	20-45 days	8	4 - referred to higher centre	2
	4 (developed later)	7-21 days	4	0	0
	65		51 (78.4%)	9 (13.8%)	5 (7.6%)

DISCUSSION

This prospective study of empyema thoracis in children at a tertiary care centre found good pulmonary outcome with conservative therapy alone. The age of presentation and male predominance was similar to previous studies.¹⁰⁻¹³ A higher incidence of empyema has been reported in undernourished children, as seen in our study also (64.6%).¹⁰ Fever, cough, breathing difficulty and abdominal pain and distension were the common symptoms found. Underlying consolidation was present in 60% of all patients of empyema, implying that most cases occurred as a complication of bacterial pneumonia. Cham CW et al in their study on 39 consecutive patients of empyema also found that the commonest cause of empyema was post-pneumonic.¹⁴ Staph aureus was the commonest organism cultured from pleural fluid in 58.4% cases while 35.3% of pleural fluid samples were sterile due to previous use of antibiotics, which is similar to that reported in the literature.^{11,14-16} In the study done by Eastham et al, commonest organism isolated was *Streptococcus pneumoniae*.³

Though empyema in children carries very little mortality as compared to adults, it causes lot of morbidity and complications if pus is not drained or due to rupture of pneumatoceles.¹³ Often cases are referred to the tertiary care hospital after several days of symptoms and receive

inadequate/ inappropriate treatment. In our study, the median duration of symptoms before admission was 15 days (range 5-40 days). Two patients which were referred after 30 days, were inappropriately on ATT and had developed empyema necessitans due to non-evacuation of pus, 2 had stage III (organized) empyema at admission. The incidence of complications seen in our study is comparable to other studies.^{4,13}

Most of the cases in our study with delayed presentation were successfully treated by intercostal tube drainage and antibiotics with/without fibrinolytic (71.4%) and showed complete clinical and radiological resolution of empyema and re-expansion of the lung without the need for surgical intervention like VATS (overall success rate in our study was 78.4%).

Avansino JR et al conducted a meta-analysis and suggested that primary operative therapy of empyema is associated with lower mortality rate and morbidity as compared to conservative management whereas McLaughlin JF et al and Gocmen A et al emphasized that most children with loculated empyema can be treated with antibiotics and chest tube drainage and surgery is required in few cases only.¹⁷⁻¹⁹

In the study done by Baranwal et al, success rate of medical management over surgery was 79% which is

similar to our finding.¹⁶ Satpathy et al reported a success rate of 90.5% with conservative management which is higher than present study.²⁰ This difference was because majority of the patients in our study had presented late and the incidence of complications was higher in this study.

Only 2 patients needed both intercostal drainage and decortication. They had presented after 40 days and had thick septations with organized empyema on CT scan; 3 patients were treated by VATS. Four patients with bronchopleural fistula at admission did not improve with conservative management despite prolonged drainage and were referred to higher centre for investigation and management, 2 patients died. The mortality rate in our study was 7.6% which was almost similar to other studies (3.3%-10%).¹³⁻¹⁵

Previous studies have reported that intrapleural fibrinolytics reduce the need for surgery and duration of hospitalization while in some studies VATS was preferred in late phase.^{7-9,13,17,18,20} In this study we have shown that ICD with fibrinolytics can reduce the need for surgery even in late stage. No major adverse effects of fibrinolytic therapy were noticed in our study subjects.

The main limitation of our study was that majority of children who were discharged were lost to follow up and could not be assessed clinically and radiologically.

CONCLUSION

Majority of cases of empyema in children are post-pneumonic. Hence morbidity and mortality can be reduced by adequate treatment of bacterial pneumonia. In all patients with loculations except those with a bronchopleural fistula, fibrinolytic therapy should be tried. Chest tube drainage, antibiotics along with intrapleural fibrinolytic is a safe and effective method of treating empyema thoracis in children in resource- poor settings and can reduce the need for invasive interventions, such as thoracoscopic debridement or open surgery.

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