Indian J Pediatr (November 2011) 78(11):1371–1377
DOI 10.1007/s12098-011-0416-y

ORIGINAL ARTICLE

Empyema Thoracis: Analysis of 150 Cases from a Tertiary Care Centre in North East India

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Received: 15 November 2010 / Accepted: 10 March 2011 / Published online: 8 May 2011

Abstract
Objectives To analyze the clinical characteristics, microbiological profile, management, complications and outcome of cases with empyema thoracis.
Methods All cases diagnosed as 'empyema thoracis' over a period from January 2006 through June 2010 were identified from the inpatient records and discharge summaries. Of the 160 cases identified, 150 cases were taken up for analysis and the rest 10 cases, of which two had significant predisposing co-morbidity and eight cases diagnosed as tubercular empyema thoracis were excluded from the analysis.
Results Mean age of presentation was 4.74±3.53 years and two thirds of the children were under 5 years with male to female ratio of 1.42:1. Pus culture was positive in 32% (48 cases) with *Streptococcus pneumoniae* being the commonest organism isolated (31 cases, 64.6%) followed by *Staphylococcus aureus* (11 cases, 22.9%), *Klebsiella pneumoniae* (3 cases, 6.3%), *Haemophilus influenzae* type b (2 cases, 4.2%) and Enterococcus (1 case, 2%). Clustering was seen in the hot and humid months from April to July (63.3%). Fever was the commonest presentation (96.7%) followed by cough (90%), breathing difficulty (66.7%), chest pain (26.7%) and pain abdomen (10.7%). Ampicillin and cloxacillin was used as the first line antibiotic in 57.3% cases. Average duration of intercostal water seal drainage (ICWSD) in situ was 13.5±8.05 days and 59 patients (39.3%) received fibrinolytic therapy. The commonest complications were collapse (18%), thickened pleura (16.7%), pericardial effusion (8%), cardiac tamponade (3.3%) and bronchopleural fistula (3.3%). Surgical procedures involved in this case series were decortication (14 cases, 9.3%), pericardiocentesis (5.3%), pericardiostomy (2.7%) and pericardiectomy (1.6%). Mortality was 3.3%.
Conclusions This is the first report of empyema thoracis from the north eastern region of India. *Streptococcus pneumoniae* was found to be the leading cause of empyema thoracis in this case series. Conservative management with ICWSD and antibiotics or early use of fibrinolytic therapy if indicated are effective modalities of treatment.

Keywords Empyema thoracis · *Streptococcus pneumoniae* · *Staphylococcus aureus* · Fibrinolytics · Decortication

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Introduction

Empyema is a recognized complication of bacterial pneumonia. It continues to be a serious problem despite recent advances in management [1]. About 0.6% of childhood

pneumonias' progress to empyema [2]. Pediatric empyema, though low in incidence can be associated with considerable morbidity [3, 4]. Optimal management in children remains controversial. Treatment options include antibiotics alone or antibiotics with thoracocentesis, tube thoracostomy, intrapleural fibrinolytics [5], video assisted thoracoscopic surgery (VATS) [6] and open decortication [7]. The British Thoracic Society (BTS) gave a consensus statement regarding the lack of grade A evidence for best management practices of childhood empyema [8]. Currently, the variation in treatment options are because of the lack of randomized controlled trials and also because most children recover irrespective of the treatment they get.

The authors present 4.5 years experience (January 2006–June 2010) of empyema management in a tertiary care centre in north east India with special reference to clinical characteristics, bacterial etiology, management, outcome and complications. This is the first report of empyema from this remote part of India.

Material and Methods

All cases diagnosed as 'empyema thoracis' over a period from January 2006 through June 2010 were identified from the inpatient records and discharge summaries. Inclusion criteria was aspiration of pus from the pleural space. Exclusion criteria included patients with significant co-morbidities predisposing to serious infections and those who were diagnosed as tubercular empyema based on clinical response, levels of adenine deaminase (ADA) or biopsy findings post-surgery. The data extraction sheet used included information on age, sex, presenting symptoms and signs, laboratory investigations such as complete blood count, gram stain and culture of pleural pus, blood culture, chest radiograph and ultrasonography, drainage procedure with duration of ICWSD, operative procedures, fibrinolytics therapy, duration of fever, length of hospital stay, duration of treatment with antibiotics and complications. None of the cases were excluded due to lack of adequate data. Data were presented as mean ± standard deviation.

Department Protocol for Management of Empyema Thoracis

The present protocol was conservative treatment with antibiotics and drainage and fibrinolytics after individualization. Surgery was reserved only for non-responders or occurrence of complications such as pleural thickening, multiloculations etc. After diagnostic thoracocentesis and obtaining appropriate cultures, parenteral antibiotics were started and a chest tube was inserted in all the cases. Antibiotics were changed based on laboratory reports, or if clinical response was inadequate with the first line antibiotics. The indications for fibrinolytics (urokinase/streptokinase) were based on ultrasonography report of septation, loculation or thick and organized collection. Posterolateral thoracotomy was done when the empyema was encased by a thick peel preventing expansion, multi loculated, refractory and organized collection not responding to fibrinolytics, persistent sepsis and if patient remained unwell in spite of all conventional measures.

Results

Of the 160 cases identified, only 150 were taken up for analysis. Two cases were excluded as they had significant co-morbid conditions (cerebral palsy and mental retardation) and eight cases were diagnosed as tubercular empyema.

Profile of Cases

The demographic, clinical, laboratory findings and outcome are outlined in Table 1.

Annual and Seasonal distribution

Maximum cases were seen during the year 2009 (Fig. 1); Sixty three percent presented during the hot and humid months (April–July) (Fig. 2).

Predisposing Conditions

History of pustules was present in 13 cases (8.7%). One case had chicken pox and five had measles. Sixty eight percent of patients were malnourished and severe malnutrition by IAP grading (grade III and IV) was seen in 21% of the cases.

Clinical Presentations

The average age of presentation was 4.74±3.53 years (range 6 months–15 years), out of which the maximum cases (67.3%) were below the age of 5 years. Of these, the majority were from the age group of >1 to <3 years (Fig. 3). The male: female ratio was 1.42:1. The average duration of illness before admission to hospital was 11.54±8.34 days (range 3–30 days) and average duration for primary hospital stay was 16.41±8.72 days (range 4–45 days). Forty percent had received some form of oral antibiotics outside before being admitted and 15.2% cases were already admitted outside. Nine (6%) developed empyema during the hospital stay as a complication of pneumonia. Two patients had septic shock at admission, while one developed it during hospital stay.

Table 1 Demographic, clinical, laboratory and outcome profile of cases

		Mean ± SD or n (%)
Demographic data	Mean age	4.74±3.53 years
	M:F	1.42:1
Clinical data	Average illness before admission	11.54±8.34 days(3–30 days)
	Fever	145 cases (96.7)
	Cough	135 cases (90)
	Breathing difficulty	100 cases (66.7)
	Chest pain	40 cases (26.7)
	Laterality – Right	86 cases (57.3)
	Left	48 cases (32)
	Bilateral	16 cases (10.7)
	Pyopneumothorax	20 cases (13.3)
	Pericardial effusion	12 cases [8]
Laboratory data	Hemoglobin	9.4±1.8 g/dl
	Total count	18,016±8,718/mm3
	Platelet count	330,521±212,441/mm3
	Pleural fluid count	150–464,000/mm3 (range)
	Pleural fluid sugar <50 mg/dl	70%
	Isolation of organisms	48 cases (32)
Outcome	Defervescence	10.52±4.12 days
	ICWSD duration	13.50±8.05 days(3–35 days)
	Hospital stay	16.41±8.72 days(4–45 days)
	Ventilatory support	6 cases [4]
	Discharge against advice	13 cases (8.7)
	Death	5 cases (3.35)

Fever was the commonest presentation in 96.74% patients (Table 1). The important physical findings were tachypnea, tachycardia, pallor, bulging of involved hemithorax, intercostal and subcostal recession, shifting of trachea and mediastinal structure to the unaffected side, diminished chest movement, dullness on percussion and diminished to absent breath sound on affected side.

Laboratory Findings and Microbiological Characteristics

Culture was positive in 48 cases (32%). *Streptococcus pneumoniae* was the commonest organism isolated (31 cases, 64.6%) followed by *Staphylococcus aureus* (11 cases, 22.9%), *Klebsiella pneumoniae* (3 cases, 6.3%), *Haemophilus influenzae* type b (2 cases, 4.2%) and Enterococcus (1 case, 2%) (Fig. 4). All isolates were from pleural fluid. The antimicrobial susceptibility pattern of *S. pneumoniae* showed more than 90% sensitivity to both penicillin (29/31) and cefotaxime (30/31) and 100% (31/31) sensitivity to both chloramphenicol and vancomycin. *S. aureus* showed >60% sensitivity to penicillin (7/11) and cefotaxime (7/11), more than 80% of the isolates were sensitive to chloramphenicol (9/11) and 90% (10/11) sensitive to vancomycin. The single isolate of Enterococcus was found to be 100% sensitive to gentamicin, amikacin, ciprofloxacin, piperacillin-tazobactam and imipenem. All isolates of *K.pneumoniae* showed >60% sensitivity to ampicillin (2/3), cefotaxime (2/3), amikacin (2/3), 100% sensitivity to cefoperazone –sulbactam (3/3) and piperacillin-tazobactam (3/3).The isolates of *H.influenzae*

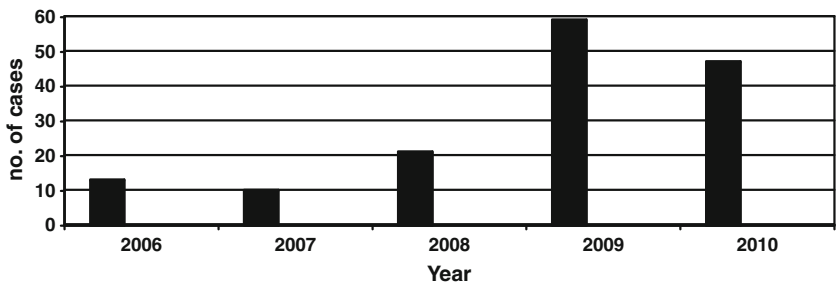

Fig. 1 Year wise distribution of cases

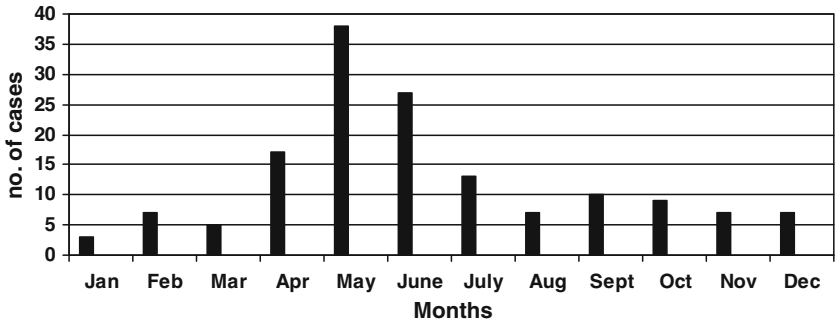

Fig. 2 Month wise distribution of cases

type b were found to be 100% sensitive to cefotaxime (2/2) and piperacillin-tazobactam (2/2) and 50% sensitivity to ampicillin, chloramphenicol and levofloxacin.

Management and Outcome

The study flow chart is depicted in Fig. 5.

The mainstay of management was ICWSD along with antibiotic therapy. The first line intravenous (IV) empirical antibiotic used was ampicillin with cloxacillin in most of the cases as per unit policy. Antibiotics were altered depending on the clinical response and or sensitivity report. Oral antibiotics were given (mainly amoxicillin) once active infection was under control, as evidenced by subsidence of fever and respiratory distress, improvement in general condition, and cessation of pus discharge, usually after 1–3 wks. ICWSD was inserted on the day of admission. The average duration of ICWSD insertion was 13.50 ± 8.05 days (range 3–35 days). Fibrinolytic, mainly Urokinase (34 cases, 22.7%) and Streptokinase (25 cases, 16.7%) were used in 59 patients (39.3%) along with low pressure suction. The indications for starting fibrinolytics therapy were ultrasonography (USG) evidence of septation, loculation, organized and thick collection. Decortication was done in 14 cases (9.3%) for uncontrolled infection, persistent fever, respiratory distress or pus discharge, large loculation and organized collection not responding to fibrinolytics, restrictive pleural thickening and bronchopleural fistula. Imaging of the chest was advised in all patients prior to surgery. Of the 14 patients who underwent surgery, CT scan of the chest could be done in only 7 patients due to economic constraints. The rest of the patients were taken up based on chest radiograph findings and clinical evaluation. Post-surgery, patients became afebrile within 3–4 days and ICWSD could be removed after 4.21±2.56 days. All had full expansion of lungs. Surgery was deferred in 15 cases as 5 patients did not give consent for operation and rest 10 patients were asymptomatic and had reasonably good lung expansion inspite of the fact that they had evidence of organizing loculations, pleural thickening or both on imaging. Twelve cases (8%) developed pyopericardium of which 7 cases underwent percardiocentesis in the Pediatric Intensive Care Unit and pericardiostomy was done in 4 cases (2.7%). Among these, 2 patients (1.6%) underwent pericardiectomy due to persistent hemodynamic instability and sepsis. Ventilatory support was needed in 6 cases (4%). Post-surgery and ICWSD, fever persisted for an average of 10.52±4.12 days. There were two cases with frank hemothorax where ICWSD was inserted after ruling out coagulation disorder and malignancy, and later pus came out. Of these, one was diagnosed as tubercular based on ADA levels and clinical response (excluded from analysis) and the second as bacterial based on good response to antibiotics. The commonest complications were collapse (18%), thickened pleura (16.7%), pericardial effusion (8%), cardiac temponade (3.3%) and bronchopleural fistula (3.3%). Five cases (3.3%) died of persistent sepsis, post operative septic shock and ventilator associated complications. Thirteen cases (8.7%) left against medical advice due to financial constraints or refusal to undergo surgery (8 patients from ICWSD group and 5 patients from ICWSD with fibrinolytics group). Most of the cases showed complete clinical resolution during follow up.

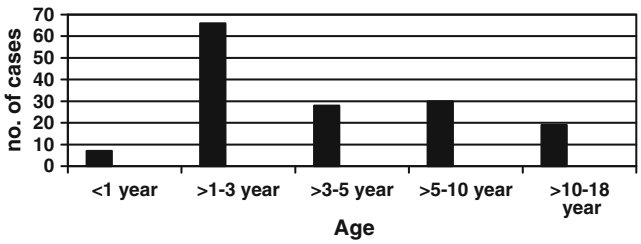

Fig. 3 Age of presentation

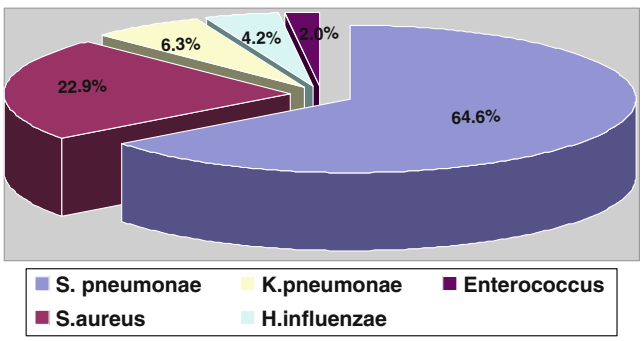

Fig. 4 Profile of organisms isolated

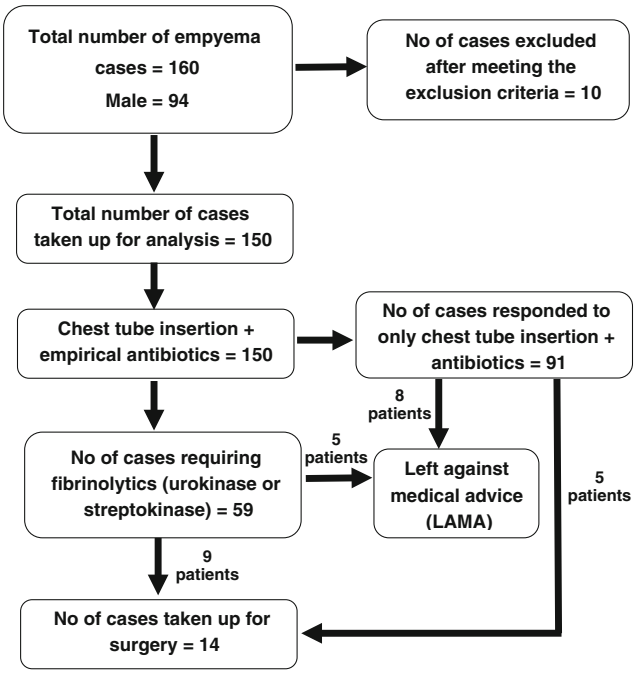

Fig. 5 Study flow chart

Separate analysis of the cases with regard to age of presentation, mortality, length of hospital stay, duration of ICWSD and complications were done for the ICWSD group, ICWSD + fibrinolytics group and decortication group (Table 2). This analysis revealed that there was no mortality in ICWSD alone group. The length of hospital stay and duration of ICWSD was more in operated group compared to the other groups.

Discussion

Bacterial pneumonia is the most common cause of pleural empyema in children [9]. The present analysis shows that most cases were in children below 5 years, thus confirming that empyema may be more likely to occur in young children. Previous studies from India also show similar results [10]. The average age of presentation in the present study was similar to previous studies [11–13].

Yield of culture was significantly lower (32%) compared to reports from other developing countries (48–82%) [10, 14–18]. It could be due to prior use of antibiotics and late referral. Another important factor is the inability to culture anaerobes, which has recently been identified as a cause of childhood empyema. A study by Brook in 72 children found anaerobes in 17 (24%) and mixed aerobes and anaerobes in 7 cases (10%) [19].

Streptococcus pneumoniae was the commonest organism isolated followed by *Staphylococcus aureus* in the present study in contrast to other studies from developing countries where *Staphylococcus aureus* is implicated as the predominant organism causing empyema especially during the hot and humid months when staphylococcal skin infection are more prevalent [10]. But following the introduction of penicillinase stable penicillins and other antistaphylococcal agents, the relative proportion of empyema due to *Streptococcus pneumoniae* has increased once more. Currently, *Streptococcus pneumoniae* appears to be emerging as the predominant pathogen in childhood empyema [8], a finding demonstrated by the present study also.

Empirical treatment of empyema still remains controversial but must cover S*treptococcus pneumoniae*, *Streptococcus pyogenes* and *Staphylococcus aureus.* Initial treatment should be guided by local antibiotic policy/restrictions. There are no data on the appropriate length of treatment and on whether different organisms require specific duration of treatment. Many centers continue with IV antibiotics until the child is afebrile or at least until the ICWSD is removed. An oral antibiotic at discharge was continued for 1–4 wks but longer if residual disease persisted [8]. Baranwal et al. [10] suggested that oral antibiotics be administered once patients became afebrile, respiratory distress subsided and significant loculations was ruled out. The BTS recommends that all patients with significant pleural infection should be treated with antibiotics and drainage of the pleural fluid [8]. In many studies, the rate of success of ICWSD was reported as being between 61% and 100% [20–23]. In the present study, all cases at admission were treated with ICWSD and antibiotics. Sixty percent of the cases in our study (91 cases) responded to antibiotics and ICWSD alone. Five cases needed decortication, and 8 cases left hospital against medical advice among these 91 cases, with an overall success rate of 52% (78 out of 150 cases).

The BTS also recommends intrapleural fibrinolytics in complicated parapneumonic effusion or empyema [8].

Table 2 Analysis of cases as per operative and non operative intervention

Parameters	ICWSD alone (n=91)	ICWSD + fibrinolytics (n=59)	Decortication (n=14)
Age in years	5.22±3.94	4.79±3.32	5.21±4.39
Mortality	0	2	3
Length of stay	14.87±8.58	18.27±7.84	26.18±8.66
ICWSD duration	12.16±8.12	15.28±7.05	21.73±10.49
Complications	35 (38.5%)	25 (42.4%)	4 (28.6%)

Several reports have documented successful drainage of multiloculated empyema using streptokinase and urokinase [5, 23]. 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 [24]. Others have concluded that fibrinolytic treatment is not an alternative to surgery, especially in loculated empyema in children [25]. Both the studies agree that fibrinolytic treatment does not reduce hospital stay or need for surgery. Fibrinolytics along with low pressure suction was used in 59 cases in the present study. Nine cases required decortication and five patients left hospital against medical advice among these 59 patients. Unlike those reported previously [24, 25], the success rate of fibrinolytics in the present study was 76.2% which suggests that fibrinolytics have a definite role in management of complicated cases of empyema thoracis bypassing the need for surgery.

Surgery is needed in persistent sepsis and pleural collection despite ICWSD and antibiotics [8]. VATS, mini-thoracotomy and decortication are available options. There are no evidence based criteria to guide the decision on when a child should proceed to surgery and consequently there is little consensus on the role of medical versus surgical management or early versus late surgery. Experience suggest that currently surgery is less frequently needed. However, there is no evidence to prove whether this is due to use of fibrinolytics or newer antibiotics [8]. VATS has an appropriate role in early surgery as failure rate is higher in advanced organized empyema. VATS was associated with a lower mortality rate, lower open surgery rate, shorter hospital day and ICWSD compared with conservative treatment [9, 23, 24, 26]. Unfortunately, the authors do not have any experience with VATS. In the present case series, decortication was performed where conservative treatment was insufficient clinically and radiologically. Studies have demonstrated the advantages of pleural decortication in Taiwanese children with empyema [27]. Karaman et al. [28] showed that the average length of stay in the open decortication group was 9.5 days compared to 15.4 days in the chest tube group. The authors applied decortication in 14 of their patients (5 from ICWSD group and 9 from ICWSD and fibrinolytics group) and 3 patients died in this group. Although post-operative ICWSD removal duration was 4.21 ±2.56 days but the total duration of ICWSD insertion and length of hospital stay in this group was 21.73±10.49 days and 26.18±8.66 days, respectively. Thus, the duration of ICWSD and length of hospital stay was higher in surgical patients compared to ICWSD alone group or ICWSD with fibrinolytics group (Table 2). This can be explained by the fact that it was a retrospective study with an intention to manage the cases more conservatively than surgery (although indicated). Limitation of resources both in terms of money and manpower and refusal of parents for early surgical intervention also added to the increased length of hospital stay.

Conclusions

Streptococcus pneumoniae was the leading cause of empyema thoracis in the present case series. The high proportion of culture negative specimens among patients with empyema suggests that culture may not be a sufficiently sensitive diagnostic method to determine etiology in majority of cases. Conservative management with ICWSD and antibiotics or early use of fibrinolytics therapy if indicated, is an effective modality of treatment. This is the first report of empyema case series over last four and half years from the north eastern region of India. More double blinded prospective randomized case control studies comparing efficacy of ICWSD, fibrinolytics therapy and early surgical intervention are required to solve the controversies in case management.

Conflict of Interest None.

Role of Funding Source None.

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