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Original article

Thoracic empyema in children: Clinical presentation, microbiology analysis and therapeutic options

Waheeb Sakran, MD [a,b,*], Zahr El Din Ababseh, MD [a], Dan Miron, MD [b,c], Ariel Koren, MD [a,b,d]

[a] Pediatric Department "B", Emek Medical Center, Afula, Israel
[b] The Ruth and Bruce Rappaport School of Medicine, Technion, Haifa, Israel
[c] Pediatric Department "A", Emek Medical Center, Afula, Israel
[d] Pediatric Hematology Unit, Emek Medical Center, Afula, Israel

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ABSTRACT

Thoracic empyema is an accumulation of purulent fluid in the pleural space presenting as a complication of bacterial pneumonia. The aims of the study were to present the incidence, demographic results, clinical presentation, laboratory and microbiology results, imaging and the therapeutic options. From January 1992 until December 2009 we collected data of children hospitalized with empyema in our medical center in north of Israel. Empyema was found in 53 pediatric patients. The median age of the patients was 3 years and 31 (58%) were male. Forty one (77%) of the cases were diagnosed in the last nine years. Fever, cough and respiratory distress were the most frequent clinical signs. In 29 (55%) patients pleural effusion was found at admission. Chest ultrasound was performed in 44 (83%) of the patients. Causative organisms were confirmed by culture in 35 patients. Positive culture was found in 17 (32%) patients in the pleural fluid. *Streptococcus pneumoniae* was the leading pathogen. The drugs the patients received at admission were penicillin in 21 cases, cefuroxime in19 cases and ceftriaxone in 11 cases. During hospitalization a change of antibiotic therapy was required, using mainly ceftriaxone and clindamycin. The pleural purulent fluid was drained by video assisted thoracoscopy surgery in 34 (64%) patients. All the children recovered. The incidence of empyema as a complication of community acquired pneumonia had increased in the last decade in our region. *Streptococcus pneumoniae* is the most common pathogen. Third generation cephalosprins and clindamycin can be suggested as a good empiric treatment.

1. Introduction

Thoracic empyema is an accumulation of purulent fluid in the pleural space as a result of a complicated pneumonia. The pus contains leukocytes, bacteria and cellular debris. In the fibrinopurulent stage usually low pH, below 7.20, and high LDH above 1000 IU can be found. The most frequent pathogens that cause thoracic empyema include *Streptococcus pneumoniae*, *Staphylococcus aureus*, Group A *Streptococcus* and rarely *Haemophilus influenzae* type b [1–4]. Several reports have shown an increase in the incidence of thoracic empyema in children worldwide [5–7]. This increased incidence of empyema occurred despite the decrease in the incidence of pneumonia following the introduction of conjugate pneumococcal vaccine [5].

The treatment of thoracic empyema depends on the clinical presentation and the stage of the disease. The initial treatment of empyema is to begin empiric antibiotic therapy for prompt eradication of the causative organism; the second step is directed to drain the purulent fluid in order to restore pleural fluid circulation, allow lung re-expansion and improve lung function [8].

Several options of interventional treatment are suggested beside the antibiotic therapy. The first option of invasive treatment is thoracocentesis or chest tube insertion with or without performing pleural rinsing with a fibrinolytic agent. An alternative option is the performance of video assisted thoracoscopy surgery (VATS) or even open decortication [8–11].

The goals of the present study are to describe the incidence, clinical symptoms and results of blood and pleural fluid cultures in a cohort of children hospitalized in a regional medical center, in the last 18 years, with the diagnosis of thoracic empyema, as a

* Corresponding author. Pediatric Department "B", Emek Medical Center, Afula 18101, Israel. Tel.: + 972 4 6495257; fax: +972 4 6495589.
E-mail address: sakran_w@clalit.org.il (W. Sakran).

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complication of community acquired pneumonia. The invasive therapeutic procedures performed were also reported.

2. Patients and methods

From January 1992 until December 2009 we collected data of all the hospitalized children with the diagnosis of thoracic empyema. The patients were admitted to our medical center, which is a regional hospital who serves the population in north-east Israel. The increase of new patients admitted from the initiation of the study till year 2009 is only 7%.

Patient's age was till age 18 years, according to the department admission policy. The diagnosis of thoracic empyema was based on three criteria: First: clinical signs, mostly dullness on auscultation, and imaging that revealed the presence of pleural fluid. Second: pleural fluid analysis with pH <7.20, LDH >1000 IU and glucose <40 mg/dl, and third: purulent fluid with positive Gram stain and/or positive pleural fluid or blood cultures. The diagnosis of thoracic empyema was based on the existence at least two of the three mentioned criteria. Pleural effusion or purulent fluid that occurred as a result of trauma, congestive heart failure, nephrotic syndrome, malignancy, hypothyroidism or esophageal perforation, were excluded. Patients know to have primary immune deficiency which includes: B or T cell defects, antibody production defect, phagocytic cell or complement protein defects were also excluded.

On admission we collected demographic data and details of clinical presentation, previous antibiotic treatment before admission and chest X-ray findings including the presence or absence of pleural fluid on admission. We also searched if any patient received conjugated pneumococcal vaccine.

Routine analysis performed during treatment in hospital included: complete blood count, pleural fluid analysis, including protein, glucose and cell count and blood and pleural fluid cultures. Initial antibiotic treatment and further antibiotics if they were changed after the primary treatment failure were described. Invasive procedures were also summarized. Results of bacterial etiology were based on positive cultures only. In patients with negative cultures no molecular diagnostic techniques were used in order to further diagnose the infection etiology.

Ethics committee approval: The study received approval from the Helsinky Committee of the Emek Medical Center, approval number: 0132-08-EMC, issued on 4 January 2009. No participants approval was requested from the ethics committee.

3. Results

Data of 53 patients was summarized, 34 (64%) were of Jewish origin and 19 (36%) of Arabic origin. The median patients age was 3 years (Mean 4.9 ± 4.1 ys, range 1–16 ys) and 31 (58%) were male. None of the patients included in the study was previously vaccinated with conjugated pneumococcal vaccine before being admitted with empyema. Forty one cases (77%), were diagnosed in the last nine years; this increase of incidence is shown in Fig. 1. The most frequent clinical signs on admission included fever in 52 (98%), cough in 50 (94%), respiratory distress in 44 (83%), vomiting in 17 (32%) and symptoms worsening as reported by the family, was present in all the patients. The median length hospital stay was 14 days (range 8–33). In spite that primary immunodeficiency was among the exclusion criteria, none of our patients were need to be excluded do to this reason.

3.1. Etiology

Causative organisms were confirmed by culture in 35 patients. Positive blood culture was found in 11 patients (21%), pleural fluid in 17 (32%) and in both sites in 7 (13%) (Table 1). No significant differences were found between young children aged less than 2 ys compared to older children aged 3 to 10 ys related to the presence of Pneumococcal infection or overall positive blood or fluid cultures ($p > 0.25 - \chi^2$ test).

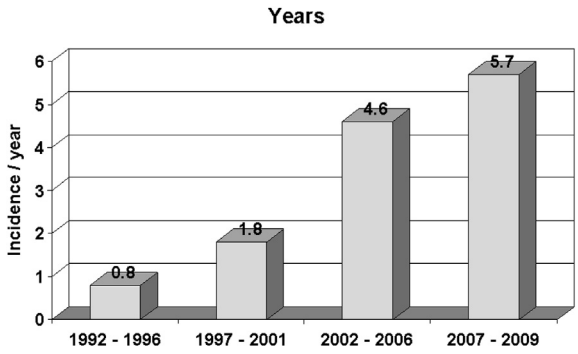

Fig. 1. Incidence of empyema in children – 1992–2009. The figure represents the mean number of new diagnosed cases per year.

S. pneumoniae was found to be the most common pathogen, followed by *S. aureus* in two patients, as single culture in one and in combination with streptococcus in the other, the remaining organisms found are shown in Table 1. We found a good correlation between Gram stain of the pleural fluid and culture; only in one patient we found Gram positive cocci while the pleural fluid culture was negative. In this case the blood culture grew *S. pneumoniae*. In three out of 16 patients who received antibiotic therapy in the community, before admission, organisms were cultured from the pleural fluid, in two cultures grew *S. pneumoniae* and in another patient the culture was positive for *S. aureus*. All the isolated *S. pneumoniae* strains were sensitive to penicillin and all the *S. aureus* were sensitive to methicillin. The patient with positive culture of *H. influenzae* type b the isolate was resistant to ampicillin and sensitive to ceftriaxone, cefuroxime and amoxicillin clavulanic acid.

3.2. Antibiotic therapy

The initial empiric antibiotic treatment on admission was penicillin in 21 (40%), cefuroxime in 19 (36%) and ceftriaxone in 11 (21%). Another two patients (3%) received roxythromycin. During hospitalization and according to the clinical signs, imaging findings, positive cultures and pathogens sensitivity the antibiotic therapy was switched to other options: combination of ceftriaxone and clindamycin in 20 patients (38%), ceftriaxone as a single therapy in 12 (22%) and in 6 patients (11%) ceftriaxone with a combination with other medications was used (Table 2). Ceftriaxone was

Table 1
Causative organisms of empyema in children 1992–2009.

Pathogen	Blood culture 11 (21%)	Pleural fluid culture 17 (32%)	Blood and pleural fluid culture 7 (13%)
Streptococcus pneumoniae	7	10	4
Group A *Streptococcus*	1	1	1
Haemophilus influenzae type b	1	1	1
Streptococcus viridans	1		
Staphylococcus coagulase negative	1		
Streprococcus group F		1	
Staphylococcus aureus		2	
Streptococcus + staphylococcus aureus		1	
Streptococcus constellatus		1	1

(): percent positive.