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Pleural Empyema in Children: Prolonged Clinical Course

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ABSTRACT

Objective: To assess the hypothesis that empyema thoracis is a problem which is often not optimally treated and to analyze evolving experience in clinical presentation, management and outcome in thoracic empyema. **Design:** Prospective observational descriptive study. **Place and Duration of study:** Department of Pediatric Medicine of Children's Hospital and the ICH Lahore from February 2008 to October 2008. **Patients and Methods:** Out of these 50 children 29 (58%) were males and 21 (42%) were females. Age range was from 06 months to 14 years. The mean duration of illness prior to hospital admission was 18 days. Ultrasonography was utilized in the diagnosis of all patients. Chest CT scan was done in 16 (32%) patients. Pleural fluid culture was positive in only 6 (12%) patients. Staph aureus was the predominating organism 4 (8%). All patients were treated with intra venous antibiotics and tube thoracostomy. Antituberculous medication was given to 6 (12%) of patients. 29 (58%) patients developed complications in the form of localized collection 12(24%), septations 8 (16%), bronchopleural fistula 7 (14%), pneumothorax 1 (2%) and hydropneumothorax 1 (2%). 12 (24%) patients were shifted to surgery department for decortication. In this study, duration of illness before visiting hospital was significantly associated with complications (p=0.04). **Conclusion:** Empyema associated with community-acquired pneumonia is an important cause of morbidity in children**. P**ara pneumonic effusion should be treated aggressively by physicians. Early drainage and proper antibiotics are recommended to prevent progression to late stage and serious complications, which in turn subjects the patient to a major surgery.

Key words: Tube thoracostomy, empyema thoracis, ultrasonography, decortication.

INTRODUCTION

Pneumonia in children is frequently complicated by pleural effusion, which rarely progress to empyema. It is estimated that 0.6% of pneumonias progress to empyema in children affecting about 3.3 per 100,000 children.[1] Empyema thoracic (ET) affects nearly 1 in every 150 pediatric patients hospitalized with pneumonia.

Although mortality rates in pediatric ET are very low, ET causes significant morbidity including substantial health care costs and burden of care. Most children with ET require prolonged hospitalization,[2] undergo multiple invasive procedures,[3] require multiple radiologic studies, and receive prolonged courses of antimicrobial, analgesic, and sedative medications.[4]

In developing countries, children less than 5 years of age are at high risk for severe, life-threatening disease associated with bacterial and viral pathogens. With the advent of antibiotics ET has become a rarity in the West.[5] However, disturbingly large number of children with this disease is still seen in Pakistan. The definite cause of this is unknown but is thought to be related to several reasons such as: the change in antibiotic prescription pattern; late referral to an appropriate centre, or as a direct effect of the introduction of pneumococcal vaccination resulting in replacement disease with serotypes not covered in the vaccine.[6] Although a majority of ET is of the pyogenic bacterial origin, 3% of it is due to tuberculosis.

ET evolve through 3 stages: stage 1, early exudative, with collection of thin reactive fluid and

few white cells; stage 2, the fibrinopurulent phase, with large quantities of white cells and fibrin deposition and formation of loculations; and stage 3, the organization phase, with thick fibrinous peel encasing the parenchyma and limiting expansion. [7]

With the increasing availability of ultrasound and computed tomography (CT) scan more accurate assessment of thoracic pathology is possible.

Therapeutic options for children with ET range from observation and intravenous antibiotics alone, chest tube drainage with or without fibrinolytic agents, and thoracoscopic decortication or open decortications. It is generally accepted that antibiotics alone or its combination with repeated needle aspiration are highly unsatisfactory in the management of ET. Intercostal tube drainage (ICD) is unquestionably the choice of management in early stages of ET. The management of ET appears to depend on the stage of pathology, the status of underlying lung and proper usage of antibiotic adjuncts. ICD of pleural space is sufficient for stage 1 empyema. Thoracoscopic decortication reduces the treatment cost and morbidity of stage 2 disease. However, stage 3 lesions with very thick pleural peels require open decortication. Recent studies support the early application of video-assisted thoracic debridement in children with empyema compared with traditional therapy, as it decreases the number of procedures and the duration of chest tube drainage and is associated with less pain and shorter recovery period than open thoracotomy. [8]

Causes of ICD failure are: diagnostic delay, postponement of ICD insertion, improper positioning of tube, improper selection of tube size, inappropriate or inadequate antibiotics, presence of bronchopleural (BPF), loculation of pus (pleural honeycombs).

Aim and objective

The aim of this study was to assess the hypothesis that empyema thoracis is a problem that is often not optimally treated and to analyze evolving experience in clinical presentation, management and outcome in thoracic empyema.

PATIENTS AND METHODS

This was a hospital based descriptive study carried out at The Children Hospital and The Institute of Child Health, Lahore, from February 2008 to October 2008. Data was collected prospectively. Children ≤16 years of age admitted to General Medical Ward I diagnosed to have pleural effusion on the basis of clinical, radiological and laboratory reports of diagnostic tapping were eligible. Patients having clinical and/or laboratory evidence of transudative pleural effusion, like congestive cardiac failure, nephrotic syndrome or hypoproteinaemia due to any other cause were excluded from the study. A detailed history and thorough clinical examination was undertaken for each patient. Their clinical features were noted focusing mainly on age, gender, presenting symptoms, examination findings and total hospital stay. Routine investigations including complete blood count (CBC), ESR, X-ray chest (CXR) and chest ultrasound were performed for all patients. Thoracentesis and pleural fluid analysis were also performed. CT scan chest was performed in selected patient who did not show resolution of symptoms along with prolonged hospital stay and suspicion of development of complications. Following diagnosis, the patients were treated with chest drain insertion and intravenous antibiotics: 2nd generation cephalosporin alone, cephalosporin plus benzyl penicillin or vancomycin plus benzyl penicillin. Antibiotics were changed to second line according to culture and sensitivity report of pleural fluid analysis or empirically if the patient did not show improvement. Antituberculous drugs were added on basis of prolonged history, unvaccinated child, history of contact with tuberculous patient, raised ESR, pleural fluid lymphocytosis or positive montoux test. Repeat chest drain insertion was done if large amount of pleural fluid re accumulated or patient developed complication like pneumothorax or hydropneumothorax.

These patients were followed during the stay. Complications were noted. Outcome of patients was noted in form of discharged, died, left against medical advice (LAMA) or shifted to surgery ward for decortications.

Statistical Analysis

All the data was recorded in predesigned proforma and the results were analyzed using SPSS

version 16 software. Variables were summarized using frequencies and percentages for categorical variables, and median, and range for continuous variables. The chi-square test was used for statistical analysis.

RESULTS

Out of these 50 children 29 (58%) were males and 21 (42%) were females with M:F ratio of 1.3:1. Age range was from 6 months to 14 years. About two-third of patients (72%) were below 5 year of age (36/50). (Table 1) The common presenting symptoms were fever, cough, breathing difficulty and pain in lower chest or upper abdomen. (Table 2) The mean duration of illness prior to hospital admission was 18 days (range 5 to 40 days). In our study, duration of history before visiting to hospital was significantly associated with complications (p=0.04). Ultrasonography was utilized in diagnosis of all patients and played an important role in directing management plans. Chest C T scan was done in 16 (32%) patients. Duration of hospital stay was 9-32 days with mean length of stay 16.88 days. (Table 1). Consolidation of underlying lung was present in 31 (62%) patients. 43 (86%) patients were anaemic with hemoglobin level less than 11 mg/dl. 33 (66%) patients had leucocytosis and 34 (68%) had neutrophil count > 60%. Thick pus was present in pleural fluid in 28 (56%) patients. Pleural fluid culture was positive in only 6 (12%) patients. Staph aureus was the predominating organism 4 (8%), followed by Pseudomonas 1 (2%) and Klebsiella 1 (2%) (Table 3). All patients were treated with intravenous antibiotics and tube thoracostomy. Antituberculous medication was given to 6 (12%) patients. ICD time range was 5 to 20 days. Additional pleural drainage procedure with 2nd chest drain insertion was performed in 9 (18%) patients. 1 (2%) patient had bilateral thoracostomies. Median length of stay (LOS) was 16.88 days with a range of 9–32 days. 29 (58%) patients develop complications in form or localized collection 12 (24%), septations 8 (16%), bronchopleural fistula 7 (14%), pneumothorax 1 (2%) and hydropneumo-thorax 1 (2%) (Fig. 1). 37 (74%) patients were discharged home, 1 (2%) patient LAMA and 12 (24%) patients were shifted to surgery department for decortication.

Table 1: Demographics, imaging study and outcome of 50 children with pleural effusion.

Category	Total n=50 (%)
Age (Years)	
< 1	08 (16%)
1-5	28 (56%)
5-10	11 (22%)
> 10	3 (6%)
Sex (M:F)	1.3:1
Male	29 (58%)
Female	21 (42%)
Mean duration of hospital stay	16.88 days
Mean duration of chest tube placement (days)	8.94 days
Chest tube placement twice	9 (18%)
Chest ultrasound	50 (100%)
Chest computed tomography	16 (32%)
Complications	29 (58%)
Out come	
Discharged	37 (74%)
Left against medical advice (LAMA)	01 (2%)
Referred for surgery/ decortications	12 (24%)

Table 2: Clinical features

Clinical features	Total (n=50)	
	No.	%
Fever duration		
< 7 days	12	24%
8-15 days	17	34%
16-20 days	7	14 %)
21-30 days	7	14 %
> 30 days	7	14%
Cough	50	100%
Dspnoea	39	73%
Chest pain	7	14%
Intrathoracic pathology		
Right sided pleural effusion	21	42%
Left sided pleural effusion	28	56%
Bilateral sided pleural effusion	1	2%
Underlying consolidation	31	62%
Treatment		
1st line antibiotics	50	100%
2nd line antibiotics	20	40%
Anti-tuberculous drugs	6	12%

Table 3: Laboratory parameters

Parameters	Total (n=50)	
	No.	%
Hemoglobin (mg/dl)		
< 5	2	4%
5-8	10	20%
8-11	31	62%
> 11	7	14%
Total leucocyte count		
< 5000	1	2%
5000-10000	16	32%
10000-20000	28	56%
> 20000	5	10%
Neutrophils		
< 40%	6	12%
40-60%	10	20%
> 60%	34	68%
Pleural fluid		
Thick pus	28	56%
Cell/L		
<2500	7	14%
2500-5000	12	24%
> 5000	3	6%
Microorganism isolated on Pleural fluid C/S	6	12%
Staphylococcus aureus	4	8%
Klebsiella	1	2%
Pseudomonas	1	2%

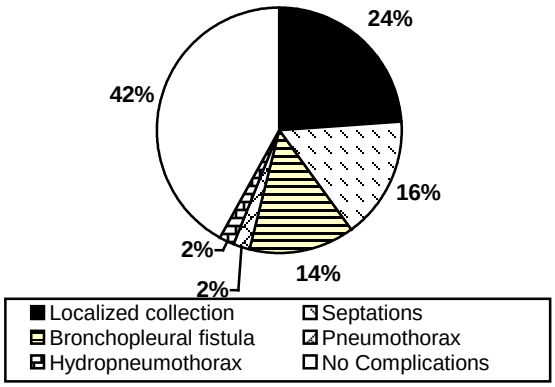

Fig. 1: Types of complications

DISCUSSION

Bronchopneumonia is a common pediatric problem, usually encountered by pediatricians and primary care physicians. Para pneumonic effusion is a well-known complication of bacterial pneumonia and its incidence can reach 40% of all patients presenting with this infection. ET in childhood carries a significant morbidity. ET is a very different disease compared to that seen in the adult population in which there is 20% mortality.[9] Conventional therapies include antibiotic alone or in combination with tube thoracostomy, minithoracostomy, thoracotomy with debridement or decortication. Newer therapies such as fibrinolytics and thoracoscopy have also been described.

The demographic analysis shows a high proportion of patients having male gender 29 (58%) and female 21 (42%), with a male to female ratio of 1.3:1. This may signify the male dominance and sex discrimination in South East Asia. A preponderance of males was noted in all countries (62% in China and Korea and 57% in Taiwan and Vietnam).[10] A study from Bangladesh also showed higher positivity in male children, (66.7%). [11]

In our study, 72% of our patients (n=36) were below 5 year of age confirming that ET may be more likely to occur in young children than in older children. In India, a study conducted by Baranwal AK one-third of hospitalized children with empyema were <5 years of age[12]. The mean age (4-5 years) of children with empyema and pleural effusion in our study was similar to findings elsewhere.[13-16]

The symptoms analysis of pleural effusion is shown in Table-I. In this study common clinical features of pleural effusion were cough and fever followed by respiratory difficulty and chest pain and this is in concordance with a study from Bangladesh and Pakistan[11, 14]

In our study 28 (56%) had left sided, 21 (42%) had right sided and 1 (2 %) of patients had bilateral pleural effusion A study conducted by Bhatta NK and et al reported that right sided effusion was found in 59% and bilateral effusion in 7.7% of children.[17] Bilateral ET is infrequently reported in children. In a comparative review of 243 children with ET, Baranwal et al[12] found a frequency of 5% of bilateral empyemas. While none of the 79 patients with ET managed by Gün et al had bilateral disease.[18]

Our study identified culture positivity in 6 (12%) of patients and S. *aureus* was the most common organism isolated 4(8%) followed by gram negative organisms like pseudomonas and Klebsiella consistent with the study by Yin CC[19] and another study by Raza AB[16]. In a study from Nepal showed culture positive effusion was found in 6.4% patients only.[20] Previous reviews or case series describing bacterial organisms isolated from children with ET suggest that Gram-positive as well as Gram-negative organisms may invade the pleural space[21]. In our study, a high proportion (88%) of all empyema and pleural fluid specimens grew no bacterial pathogen. This finding is consistent with a number of previous studies suggesting that the negative cultures are not the result of limitations in routine microbiology laboratory procedures. The negative cultures more likely are due to the widespread use of antibiotics (including inappropriately chosen or dosed antibiotics) as well the potential for severe viral lower respiratory tract disease to be associated with pleural effusion and bacterial superinfections resulting in necrotizing pneumonia and empyema [22]

CT scans detects more lung parenchymal changes than chest X-rays, its routine use in children is not recommended. Chest CT has a role in complicated cases where children are not clinically improving or if malignancy is suspected. Surgeons may request a chest CT before surgery as a 'road-map' for the procedure. [19] In our study CT scan chest was requested for16 (32%) patients with pronged clinical course.

All children were treated with antibiotics. 6 (12%) of patients required antituberculous treatment and tuberculosis as an etiology of pleural effusions is consistent with study done by Raza AB,[16] but a study by Khanzada[24] showed that the most common indication for tube thoracostomy was tuberculous effusion (36.1%). One in three patients (31%) received anti-tubercular drugs in a study from Nepal.[25]

The average length of hospital stay in our study was 16.88 days and was longer (range, 9-32 days) than that reported in previous studies (range, 9-17 days).[25] The results of our study are comparable to that of Avansino[26] but are somewhat different from that of Schultz et al.[27] In our study 24% patients were referred to surgery for decortication consistent with the study by Hasan M et al[11] and Schultz et al[27] in which 25% and 23.6 % respectively had decortication after failed chest tube drainage. In a study from Phillipines over a 14 year period, 31 children managed only by tube thoracostomy were studied. Sixty four percent did not achieve lung reexpansion even after 3 weeks and most had prolonged hospital stay.[28] A study from Liverpool[29] conservative management was seen to result in prolonged fever and recurrent effusions in 20% cases leading to prolonged hospital stay consistent with our study in which 9 (18%) of patients required repeat chest drain insertion resulting in prolonged clinical course.

In our study complication were noted in 29 (58%) which were residual effusion, bronchopleural fistula, localized collection, septations, pneumothorax, hydropneumothorax comparable with the study by Raza AB.[16] Prolonged history of fever before diagnosis of pleural effusion in our study was significantly associated with complications (p value 0.049). In a study by Shankar KR[29] major complications were noted in 15% who had significantly delayed thoracotomy which included recurrent empyema with lung abscess, scoliosis, restrictive lung disease, bronchopleural fistula and sympathetic pericardial effusion.

Karaman et al[30] compared 30 children with empyema who were randomized prospectively to receive open thoracostomy or chest tube. Average length of stay in the open decortication group was 9.5 days as compared to 15.4 days in the chest tube group. In this series secondary surgery was delayed by an average of 18.5 days after chest tube drainage failed consistent with our study.

There are many treatment options but unfortunately results with these treatment regimens have been highly variable. As a result, the optimum therapeutic strategy for ET has yet to be elucidated. Moreover, the availability of non-operative alternatives frequently results in delayed surgical consultation, and ultimately, increased patient morbidity and mortality. Determination of the stage of the empyema has been reported to be crucial in choosing an appropriate therapeutic option.

CONCLUSION

Empyema associated with community-acquired pneumonia is an important cause of morbidity in children**.** Staph aureus is the most common infecting organism. Early drainage and proper antibiotics are recommended to prevent progression to late stage of loculation or formation of thick fibrotic peel around the lung. Delay in the management of a simple infection can give rise to a serious complication, which in turn subjects the patient to a major surgery. It is suggested that pediatricians must be convinced about the benefits of early surgical intervention and they must be encouraged to refer patients early.

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