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PAEDIATRIC THORACIC EMPYEMA IN AN ETHIOPIAN REFERRAL HOSPITAL
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ABSTRACT

Objectives: To analyse underlying conditions, clinical manifestations, aetiologic agents and management of empyema thoracis and to determine the outcome of the disease.

Design: A retrospective study.

Setting: Ethio-Swedish Children's Central referral (teaching) Hospital, Addis Ababa, Ethiopia.

Subjects: Thirty eight patients with a discharge diagnosis of non-tuberculous thoracic empyema seen from January 1988 to December 1992.

Results: The incidence was 2.7/1000 admissions, which is higher than that reported elsewhere. Sixty six per cent of the patients were under five. Pneumonia was the antecedent illness in almost all cases. Fever, dyspnoea and signs of respiratory distress and effusion were the commonest presenting features. Bacteriological examination revealed *Staphylococcus aureus* as the commonest aetiologic agent (58%). All patients were treated with antibiotics, and drainage of the empyema was effected by closed thoracostomy in 71% of the cases, while the rest were managed with thoracentesis alone. The case fatality rate was 16%. A long hospital stay and high rate of complications were also observed.

Conclusion: Empyema is not rare in our practice. Early diagnosis and proper treatment of pneumonia prevents the development of empyema. Therefore, establishing an efficient management protocol that is relevant to our particular set up is required.

INTRODUCTION

Acute respiratory infections are the most common illnesses of childhood accounting for about 50% of all illnesses in under fives and 30% in the 5-12 year age group, largely involving the upper respiratory tract. However, about 5% involve the lower respiratory tract resulting in serious diseases especially the bacterial pneumonias(1). Forty per cent of bacterial pneumonias are said to be complicated by parapneumonic effusions, 10% of whom would evolve into empyema(2).

The advent of chemotherapy had only reduced the incidence of thoracic empyema by controlling the infection before it develops, however, the mortality rate from empyema has not changed(3). Therefore, the current recommendation in the management of patients with empyema is early thoracostomy depending on the pH, glucose and lactate dehydrogenase level of para-pneumonic effusions before the development of empyema(2).

MATERIALS AND METHODS

The clinical records of all patients with a discharge diagnosis of non-tuberculous thoracic empyema seen at the ESCH during a 5-year period (January 1988 - December 1992) were reviewed. The ESCH is the only central referral and teaching hospital

admitting children below the age of 14 years. Medical records were studied with respect to underlying conditions, clinical manifestations, microbiology, treatment and outcome.

The inclusion criteria used by Varkey *et al*(3) were applied in this study. Accordingly, the presence of at least one of the following findings on pleural fluid analysis was used to define the cases. These criteria include: (i) grossly purulent fluid; (ii) a positive Gram stain or culture and (iii) white blood cell count >10,000 mm³ with predominant polymorphs.

Thirty eight fulfilled the study criteria out of 42 patients who were managed as cases of empyema thoracis. Only aerobic cultures were used throughout since facilities for anaerobic, mycobacterial, fungal cultures or sensitivity tests were not available. All chest radiographs were read by a radiologist and the degree of pleural involvement was classified into: (a) Small – some costophrenic angle blunting; (b) Medium – involving up to half of the hemithorax and; (c) Large – involving over more than half of the hemithorax with/without mediastinal shift(4).

Statistics were computed using Epi-Info version 5 program.

RESULTS

During the study period, 38 children were treated in ESCH for empyema thoraces. Twenty five patients (66%) had a positive Gram stain and/or culture. The remaining 13 patients with grossly purulent pleural fluid had negative bacteriologic studies. These were made up of 22 males and

16 females, sex ratio 1.4:1. The total number of children admitted to the hospital during the same period was 14,176 with 944 cases (7%) of non tuberculous bacterial pneumonia. The incidence of childhood empyema in this series was 2.7/1000 admissions accounting for 4% of the cases of bacterial pneumonias. The age range was from five days to 12 years with a median of three years. Sixty six per cent of the patients were under-fives (Table 1).

Table 1

Age distribution of the 38 empyema cases

Age (years)	Subtotal		Cumulative	
	No.	%	No.	%
<1	8	21	8	21
1 - <2	6	16	14	37
2 - <5	11	29	25	66
5- 12	13	34	38	100
Total	38	100		

Hospital stay of these patients span between two hours and 98 days with a mean of 32 days.

All cases, except one patient who had a sewing needle in the right pleural space from a penetrating chest injury, are secondary to pneumonia. However, three patients had documented preceding illnesses; namely, measles, pyogenic meningitis of undetermined aetiology and acute glomerulonephritis.

These patients were admitted three days to three months after the onset of the illness with a mean of 11 days. The commonest manifestation in all ages were fever, dyspnoea, cough, respiratory distress and signs of pleural effusion. However, toxic features, cyanosis, congestive heart failure and signs of consolidation were more frequently seen in infants below two years than in older age groups (Table 2). Half of them were under weights for age with one case of marasmus and another marasmic – kwashiorkor. The empyema was localised on the right side in 23 patients (60%), left in 14 cases (37%) and bilateral in one. Fifteen patients (40%) had massive collection with/without mediastinal shift evident both clinically and roentgenographically.

In twenty nine (76%), the pleural aspirate was grossly purulent, cloudy in five (13%), haemorrhagic in three and sero-fibrinous in one case. The WBC count of the fluid ranged from 2880 - 50,000 mm³ with a mean of 21,000 mm³ and five patients who fulfilled the inclusion criteria had counts below 10,000 mm³.

All patients had bacteriologic studies, Gram stain and/or culture. Overall, 25 patients (66%) had their offenders identified; 15 (39%) by Gram stain alone, seven (18%) by both Gram stain and culture and three by culture alone. Culture became positive in 10 (32%) of the 31 patients

Table 2

Clinical manifestations of empyema cases by age group

Manifestation	<2 years		>2 years		Total	
	No	%	No	%	No	%
Symptom:						
Fever	14	100	24	100	38	100
Dyspnoea	14	100	24	100	38	100
Cough	13	93	24	100	37	97
Chest pain	0	0	18	75	18	47
Vomiting	5	36	8	33	13	34
Sign:						
Fever	14	100	24	100	38	100
Resp. distress	14	100	24	100	38	100
Effusion	10	71	22	92	32	84
Consolidation	6	43	6	25	12	32
Septic features	6	43	6	25	12	32
Cyanosis	3	21	8	2	5	13
CHF(*)	2	14	1	4	3	8
Meningismus	1	7	0	0	1	3

(*) Congestive heart failure

from whom specimen for culture was taken. In seven of these cases (70%) the empyema was due to *Staphylococcus aureus* and in the rest, *Streptococcus pneumoniae*, - haemolytic streptococcus, *Klebsiella pneumoniae* and *Proteus vulgaris* were isolated. Only the patients with foreign body in the pleural space had mixed infection with *Klebsiella pneumoniae* and *Proteus vulgaris*. Of the identified causative bacteria, 22 pathogens (85%) were gram positive *Staphylococcus aureus* being top on the list accounting for 15 (58%) (Table 3).

Table 3

Distribution of the 26 pathogens identified by both gram-stain and culture

Pathogen	No.	%
Gram-positive		
<i>Staph. aureus</i>	15	58
<i>Strep. pneumoniae</i>	4	15.4
Other streptococci	3	11.5
Subtotal	22	84.6
Gram negative		
<i>Klebsiella pneumoniae</i>	1	3.8
<i>Proteus vulgaris</i>	1	3.8
Unspecified	2	7.8
Subtotal	4	15.4
Total	26	100

Of the twelve patients who had blood cultures at admission, there was only one case with a growth of - haemolytic streptococcus, which was consistent with the pleural fluid isolate.

All patients were treated with antibiotics after the diagnosis of empyema was made. Twenty eight patients (74%) were given cloxacillin while six patients (16%) got penicillin plus chloramphenicol and the remaining four

received crystalline penicillin alone. Twenty six patients (68%) had antibiotic pre-treatment before pleural fluid was obtained for diagnosis.

Drainage of empyema was effected by closed thoracostomy in 27 (71%) patients while eleven were managed with thoracentesis alone. The empyema fluid yield during the first three days of drainage was in the range of 25 to 1600 cc with a mean 450 cc. Thoracotomy and removal of needle followed by closed drainage was done on the patient with intra-pleural foreign body. Decortication and sequestrectomy was done on a patient who lately developed fibrotic pleurisy and rib osteomyelitis after an initial period of simple closed tube drainage. Re-insertion of chest tube was made for a total of nine patients (33%), the reason being pneumothorax in four and recollection of pus in five cases.

Two third of the patients had stayed in the hospital for over three weeks and 17 (45%) patients developed complications. The commonest complications were chest wound infection, pneumothorax and superinfection of empyema (*E. coli*, *Acinetobacter* and α -haemolytic streptococcus) (Table 4).

Table 4

Complications

Complication	No.	%
Wound infection	5	26.3
Pneumothorax	4	21.1
Congestive heart failure	4	21.1
Superinfection of empyema	3	15.8
Subcutaneous emphysema	1	2.6
Hospital acquired sepsis	1	2.6
Rib osteomyelitis	1	2.6
Total	19	100

Among the 32 patients who had clinical recovery 18 (47%) had normal chest findings on examination. Of these 18, only seven cases (39%) had complete roentgenographic resolution before discharge.

The case fatality rate in this series was 16% (6/38). All were males and two of them were infants. In two cases there were preceding illnesses of measles and pyogenic meningitis of undetermined aetiology while in the other four the empyema was massive. Only two had positive cultures of *Staphylococcus aureus* while the rest, all with antibiotic pre-treatment, had negative bacteriologic results. Four patients were under closed chest tube drainage, one died on the procedure of thoracostomy while the sixth one was managed by thoracentesis alone. All patients were toxic at admission and three of them had peripheral leucocyte counts $<5000 \text{ mm}^3$. Three of the deaths occurred during the first 24 hours of hospitalisation. The mean length of hospital stay in those who died was shorter by three folds than the patients who recovered.

DISCUSSION

In this series thoracic empyema cases accounted for 2.7/1000 hospital admissions which is higher than reported by Varkey (0.68/1000)(3) and William *et al*, (0.79/100)(5). But the incidence with respect to the number of non-tuberculous bacterial pneumonia cases which is 4%, is comparable to the 5% reported from a prospective study by Light *et al*(6). The higher prevalence in under-fives (66%) and the slight male preponderance (1.4:1) is in general agreement with the established pattern of acute lower respiratory infections in children(1).

White blood cell count of parapneumonic effusions is known to be a non-reliable parameter in the diagnosis of patients with empyema(2). This was observed in five of our patients (13%) who had pleural WBC count $<10,000 \text{ mm}^3$ in the presence of positive results on bacteriologic studies. This emphasises the need for microbiologic examination of suspected pleural fluid even though cell counts are low.

Even though, aetiology of empyema is known by either method in 25 patients (66%), the low culture positivity 10/31 (32%) is explained by the high rate of antibiotic pre-treatment in 68% of the cases and the absence of anaerobic cultures throughout the study period. Currently, most culture-negative empyemas are believed to be due to anaerobes as shown by the ever increasing rate of anaerobic isolation with improved bacteriologic techniques. The highest recent report in adults is 38.8%(3). On the other hand, the higher yield of the Gram stain, 22/36 (61%), makes it more commendable in our circumstance, though specific aetiological diagnosis may be difficult sometimes.

Reports show a major shift in the aetiology of empyema from the pre-penicillin era of *Pneumococcus* and *Streptococcus pyogenes* to *Staphylococcus aureus* and gram negative rods including *Haemophilus influenzae* and *Enterobacteriaceae*(3). The identification of *Staphylococcus aureus* in 15 of our patients (68% of the positive cases) followed in decreasing order by *Pneumococcus* and *Streptococcus pyogenes* fits well into this picture. However, no cases of *Haemophilus influenzae* empyema was documented though there were two cases with unspecified gram negative rods identified on Gram-stain alone.

Twenty seven patients (71%) were satisfactorily managed with thoracostomy of whom nine needed re-insertion of tube. Only two patients required further surgical procedure, which is low compared with that seen in other series, 26-36%(3).

A number of our patients, 17 (4%), had some form of complications in the acute phase of their illness. Only one case developed chronic empyema with fibrotic pleurisy and rib osteomyelitis. None of the patients developed distant metastatic infection.

Chest radiographs of seven patients alone were read as normal at discharge which goes with slow radiological resolution expected in empyema patients(6).

Reports of overall mortality including those with underlying disease in adults showed a rate in the range of 11.2-48.5% while only about 25% of these deaths were attributed directly to the empyema(3). In children in two large series that took 30 and 25 years each, the mortality rate in acute postpneumonic empyema cases were 13% and 16.5% respectively(7,8). And the mortality rate of 16% (6/38) in our cases is comparable to these studies, most of our isolates being *Staphylococcus aureus* with its known high fatality of 10-30%(9). However, in a recent study done in south Eastern Nigeria, a low fatality rate of 6% was recorded(10).

Factors affecting case fatality were analysed by different authors. Age was found to be the single most important factor affecting mortality with the highest rate in infancy(3,11). Gourlay has shown the significant impact of duration of illness(12). In addition the inadequacy of drainage by multiple thoracentesis is shown by increased mortality(7).

Such clear cut associations with previously known risk factors could not be demonstrated in our series. Apart from a possible difference in host-agent interaction, this could partly be explained by the fact that the number of cases was small.

Knowing that empyema is not so rare in our practice and that this retrospective study has limitations in making definite conclusions, an extended prospective study with improved laboratory support is recommended. This will help in setting up a management protocol that is relevant to our particular setting. Important questions that can be addressed in such a study could be aetiologic identification and their antibiotic sensitivity pattern as well as the impact

of factors like age, nutritional status and duration of illness on outcome.

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