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Empyema thoracis in children: Still a challenge in developing countries

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ABSTRACT

Background: To evaluate the effectiveness of surgical intervention in managing empyema thoracis in children. **Patients and Methods:** A total of 70 patients aged 1-14 years diagnosed to have empyema thoracis and who underwent tube thoracostomy from January 2010 to December 2013 were studied. All patients of which 12 patients needed decortication. **Results:** The mean age of the study group was 5.44 years and 48.6% were male and 51.4% were female. The most common symptoms at admission were fever (90%), dyspnoea (73%), cough (70%) and chest pain (23%). Pleural fluid cultures were sterile in 60% of patients. The most frequently identified micro-organisms was *Staphylococcus aureus* (34.2%). Treatment with chest tube drainage was successful in 55 (78.6%) patients. Three patients got expired. Twelve patients had decortications, all of which were successful. The lung re-expansion time was 8.00 ± 1.68 days (range: 5-13 days) in those patients in whom chest tube drainage was successful, whereas it was 7.50 ± 2.623 days (range: 4-14 days) in patients in whom decortication was done. The post-procedure stay was 10.00 ± 1.809 days (range: 7-15 days) in patients with successful chest tube drainage and 9.5 ± 2.902 days (range: 6-17 days) in case of decortication cases. **Conclusion:** Tube thoracostomy should be done in all cases of empyema thoracis regardless of stage, as this leads to reduction in septic load. Decision of decortication should be taken without any delay.

Key words: Decortication, empyema thoracis, tube thoracostomy

INTRODUCTION

Hippocrates defined empyema thoracis as a collection of pus in the pleural cavity.[1] It is a significant cause of paediatric hospital admissions and paediatrics morbidity, especially in developing countries where hospital resources are scarce.[2-4] The proper management of empyema thoracis in children continues to be a source of debate. It continues to have a high mortality rate (10-16%).[5] Pleural effusion and empyema are known complications of bacterial pneumonia. Effusion occur in at least 40% of bacterial pneumonias, with up to 60% of effusions resulting in the formation of empyema in all age groups.[6,7]

It occurs when bacteria invade and propagate in the normally sterile pleural space. The American Thoracis Society has described three stages of empyema, namely exudative, fibrinopurulent, and organized.[8] The exudative phase (1-3 days) is caused by increased permeability of the inflamed pleura. The fibrinopurulent phase (4-14 days) is characterised by accelerated fibrin deposit, becomes purulent leading to empyema and loculations and the organising stage (after 14 days) is characterised by thickened pleura, producing an inelastic membrane 'the peel,' which restrict lung movement termed as trapped lung. It is postulated that most appropriate therapy depends on stage of disease at presentation.

Staphylococcus aureus is the most common cause in the developing world, while the *Streptococcus pneumoniae* in the developed world.[9,10] The reported rates of identifying an infectious cause from pleural fluid vary from between 8% and 76%, respectively. Pleural fluid is sterile due to widespread early use of antibiotics.[11,12] Other causes are *Streptococcus pyogenes*, *Haemophilus influenza*, *Mycobacterium* species, *Escherichia coli* etc.

Various treatments have been employed including antibiotics, thoracocentesis, tube thoracostomy, intrapleural fibrinolytics, open window thoracostomy, video-assisted thoracoscopic surgery (VATS) and thoracotomy. Unfortunately, results with these treatments have been highly variable.[13-16] This

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study is carried out to evaluate the effectiveness of surgical intervention in managing empyema thoracis in children.

PATIENTS AND METHODS

A prospective study of 70 children in the age group of 1-14 years diagnosed to have empyema thoracis, admitted from January 2010 to December 2013 in our medical college, which is catering the needs of the border and rural area of Punjab. The diagnosis was established on the basis of history, examination, and investigations, including X-ray chest (Figure 1) and culture and sensitivity of pleural fluid. Ultrasonography (USG) and computed tomography (CT) scan were done in selected cases only. All cases having empyema thoracis (pus on aspiration from the pleural cavity) were included. Patients diagnosed to be having tuberculosis or other associated lung diseases such as interstitial, malignancy were excluded. Any patient found tubercular during the study was also excluded. Written informed consent was taken and the respective procedures were well-explained to patients parents or whosoever was available. The demographic characteristics of patients were noted.

All patients underwent closed intercostal tube drainage with size 20-24 Fr. The chest tube was inserted in the operating room under full monitoring equipment. Chest tubes were usually put by residents under the guidance of consultants. As a routine empirical intravenous antibiotics and supportive treatment mainly maintenance of hydration, oxygenation, nutrition, blood transfusion, and nursing care were given to all patients. The progress of the patients was assessed on the day-to-day basis, in terms of respiratory rate, fever charting, drain output, and serial chest X-rays.

The chest tube was removed after clinical improvement, that is when no or below 30 ml drain output was documented for more than 24 h, and the radiological lung re-expansion, in both cases that is tube thoracostomy and decortications. Antibiotics were changed based on culture and sensitive reports.

Decortication was subjected to the cases who showed definitive multi-septations, thick peel encasing the collapsed lung, pleural debris with persistent fever, cough, respiratory distress, or persistent bronchopleural fistula. Decortication was done by professor unit head with posterolateral thoracotomy with or without resection of ribs (Figure 2). The intrapleural debris, fibrinous and all pus was evacuated. The thick pleural peel was carefully removed from the surface of the entire lung releasing encased lung. Peel was removed down to diaphragm. If thick peel was noted along the costodiaphragmatic surface, then peel was removed with blunt dissection taking care of the diaphragm and phrenic nerve. However, if peel was difficult to remove, it was left. All significant air leaks were meticulously closed with vicryl. Necrotic lung tissue was removed and bronchopleural fistulas were closed. Two chest tubes were placed one anteriorly and other posteriorly in every case as our unit protocol, which were attached to chest tube bags. No negative suction was used. Daily recovery and drain removal criteria were same as for tube thoracostomy. There was no treatment performed with fibrinolysis, thoracoplasty, VATS or pneumonectomy.

Data were analysed using computer software SPSS version 16 of IBM. Descriptive statistics were used to calculate mean, median, and standard deviation for variable such as lung re-expansion and hospital stay. Frequency was used to calculate bacteriological profile, sex, symptoms etc.



Figure 1: Chest roetgenogram showing a large left empyema

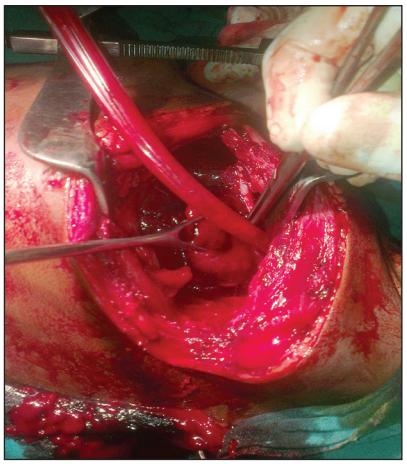


Figure 2: Operating scene of decortication

RESULTS

The mean age of the study group was 5.44 years and 48.6% were male and 51.4% were female. Nutritional status was assessed as per Indian Academy of Paediatrics (IAP) classification of malnutrition. About 10% were normal, 14.3% were in Grade 1, 15.7% in Grade 2, 28.5% were in Grade 3, 31.4% in Grade 4 malnutrition. At admission, the most common symptoms were fever (90%), dyspnoea (73%), cough (70%), and chest pain (23%). There were 57% right sided, 39% left sided and 4% bilateral effusions. Mean duration of illness in these children was 9.08 ± 3.89 days. Mean serum albumin was 2.95 ± 0.38 g/dl. Mean total leucocyte count (TLC) was 15,387.14 ± 3167.69/mm^3. Mean erythrocyte sedimentation rate was 13.84 ± 5.51 mm/1st h. Pallor was common with mean hemoglobin (Hb) was 7.38 ± 1.52 g/dl. All patients had been previously treated with antibiotics. Pleural fluid cultures were sterile in 60% of patients. The most frequently identified micro-organism was *S. aureus* (34.2%), out of which 15.7% had methicillin-resistant *S. aureus* (MRSA). Other micro-organisms were *E. coli* (4.2%), *Enterococcus fecalis* (1.4%) (Table 1). At the time of admission, 18 patients were in Stage 1, 45 patients were in Stage 2, and 7 patients in Stage 3. Mean pH was 7.16 ± 0.11, mean TLC was 756.35 ± 365.3/mm^3, glucose was 64.38 ± 8.33 mg/dl, and mean lactate dehydrogenase was 850.27 ± 252.69 of pleural fluid.

Treatment with chest tube drainage was successful in 55 (78.6%) patients. Bilateral chest tubes were placed in three patients. USG guided tubes were placed in nine patients to drain the loculated collection. Wound infection and wound dehiscence were the most common complication of tube thoracostomies. Wound infection was seen in 20% of patients and wound dehiscence was seen in 10% of patients. In one patient, chest tube was within lung parenchyma, for which lobectomy of necrotic lung was done. USG guided aspiration was done in six patients to drain post thoracostomy residual collection. In cases in which chest tube drainage failed, decortication was applied to 12 patients. The mean time taken to convert tube thoracostomy to decortication was 11 days.

Empyema was treated successfully in all patients to whom decortication was applied (n = 12). Two patients developed bronchopleural fistula after decortication, which were treated conservatively. Three patients got expired due to septicaemia.

The lung re-expansion time was 8.00 ± 1.68 days (range: 5-13 days) in those patients in whom chest tube drainage was successful, whereas it was 7.50 ± 2.623 days (range: 4-14 days) in patients in whom decortication was done.

The post-procedure stay was 10.00 ± 1.809 days (range: 7-15 days) in patients with successful chest tube drainage and 9.5 ± 2.902 days (range: 6-17 days) in case of decortication cases (Table 2).

DISCUSSION

Empyema thoracis is a life-threatening emergency. Though the incidence of empyema thoracic has declined in the west due to the effective use of broad spectrum antibiotics but it still remains a significant health problem in developing countries due to low socioeconomic status, malnutrition, and delay in diagnosis of pneumonia, delayed referral to higher centre. Furthermore, the appropriate management of paediatric empyema thoracis remains controversial.[17-19] Determination of the stage of the empyema has been reported to be crucial in choosing an appropriate therapeutic option. Duration of symptoms has been suggested as one of the means of estimating the stage of the empyema. Also, the availability of non-operative alternatives frequently results in delayed surgical consultation, and ultimately, increased patient morbidity and mortality.[13-15] In early stage of empyema thoracis, antimicrobial therapy with or without chest tube drainage remains main choice of treatment in children.[20] Tube drainage is recommended in children because of its reliability, rather than multiple thoracentesis. Several reports have documented successful drainage of multiloculated empyema using intrapleural fibrinolytic agents and VATS.[16,21-23] Several study reports shows early decortication decreases hospital stay and morbidity and mortality.[24,25] It is for these reasons that we decided to analyse our experience with management of empyema in children.

Table 1: Bacteriological profile/pus culture result

Result	Number	Percentage
No growth	42	60
Staphylococcus aureus	24	34.2
Escherichia coli	3	4.3
Enterococcus fecalis	1	1.4

Table 2: Lung re-expansion and post-procedure stay in tube thoracostomy and decortication

Procedure	Lung re-expansion (Days)	Post-procedure stay (Days)
Tube thoracostomy	8.00±1.68	10.00±1.809
Decortication	7.50±2.623	9.5±2.902

In our study, 90% of the children were malnourished as per IAP classification[26] and mean Hb was 7.38 ± 1.52 g/dl. Serum albumin averaged was 2.95 ± 0.38 g/dl. Empyema cases were seen more often in malnourished children similar to other studies conducted in developing countries.[27,28]

In our cases, pleural fluid cultures showed bacterial growth in 40% of patients and no growth in 60% of patients. Most common organism isolated was *S. aureus* which is comparable to previous studies.[14,29] MRSA was seen in 15.7% of patients, which is similar to other studies.[9]

In this study, chest tube drainage was successful in 78.6% of patients which is similar to other studies[28,30,31] and post-procedure stay was 10.00 ± 1.809 days. Decortication was done in 12 patients and was successful in all cases. Post-procedure stay was 9.5 ± 2.902 days in case of decortication. The mean time for conversion from tube thoracostomy to decortication was 11 days. Similarly previous studies have shown that early decortication decreases hospital stay and morbidity.[24,25]

Furthermore, CT scan should be used cautiously and its routine use in children is not recommended, especially in developing countries where resources are limited though few studies say otherwise.[32]

Our experience suggested that tube thoracostomy should be done in all cases of empyema thoracis regardless of stage, as this leads to reduction in septic load, and serial chest X-rays should be performed to evaluate the lung expansion. Decision of decortication should be taken without any delay. The clinical and radiological improvement after decortication is dramatic with immediate lung re-expansion and improved clinical course.

We believe that the early adequate surgical treatment in patients with empyema thoracis results in low morbidity, shorter hospital stay and good long-term outcome. However more prospective studies are needed with more number of cases and hence that proper guidelines are standardised for treatment of empyema thoracis in children.

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