CONSERVATIVE TREATMENT OF POST-PNEUMONIC THORACIC EMPYEMA IN CHILDREN

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ABSTRACT

BACKGROUND
The aim of the study is to retrospectively review data of the outcome of post-pneumonic empyema in children managed in our institute over last seven years.

MATERIALS AND METHODS
The medical records of children below 12 years of age admitted over last seven years in Government Medical College, Nagpur, with the diagnosis of post-pneumonic thoracic were reviewed. Patients with empyema due to tuberculosis, patients with chest tube drainage or any surgical intervention done before admission were excluded from analysis. The data regarding age, duration of pre-hospital illness, complaints, blood and pleural fluid analyses, radiological evaluations, microbiological studies, modes of treatment, duration of chest tube drainage and length of hospital stay was noted and analysed.

RESULTS
A total of 105 patients (65 males, 45 females) diagnosed as post-pneumonic empyema were evaluated. The peak incidence was in the 3-6-year-old group with male preponderance. A mean duration between onset of symptoms and hospitalisation was 9.32±1.68 days. The WBC counts were >15,000 in 71.12% of the patients. Examination of pleural fluid revealed frank pus in 84.38%. Bacterial growth was observed in only 27.6% patients. Radiologically, 60% patients presented in fibropurulent stage without loculations while 40% patients had loculations. 64% showed clinical improvement after the start of antibiotics and insertion of chest tube while 36% patients required the second line antibiotics after five days of admission. Chest tubes were left in place for a mean period of 8.9±5.8 days. The length of hospitalisation was 12.3±6.0 days. Twelve patients with bronchopleural fistula had hospital stay of 26±7.36 days. Three patients needed thoracotomy and decortication for continued pleural pathology even after 5 days of second line antibiotics. The relationship between presence of loculations and need for surgical intervention was not statistically significant (p<0.05). All patients improved with treatment and were clinically asymptomatic at discharge. There was no mortality in this study. At follow up, all patients were asymptomatic for their illness. All patients had normal x-ray chest at 3-month follow up.

CONCLUSION
The majority of post-pneumonic thoracic empyema cases in children can be successfully treated with a conservative approach.

KEYWORDS
Post-Pneumonic Thoracic Empyema, Paediatric, Conservative Treatment.


BACKGROUND
The empyema, an accumulation of purulent fluid in the pleural space, commonly results as a complication of a bacterial pneumonia in the paediatric population. The development of empyema can be debilitating and result in a protracted hospital course and increased morbidity. The disease process has been divided into 3 stages- Stage 1, the exudative stage; stage 2, the fibrinopurulent stage characterised by an increase in fibrin and polymorphonuclear leukocytes and beginning of loculations and stage 3, the organising stage characterised by an inelastic pleural peel. Most of the patients with empyema present in fibropurulent stage. It is agreed that prompt and effective treatment of a post-pneumonic empyema is of utmost importance to control and reverse the disease process. Many treatment modalities have been described to achieve this, but controversy remains regarding the indications and optimal timing.¹⁻⁵ Some investigators advocate antibiotics in combination with tube thoracostomy with or without intrapleural fibrinolytics while others advocate early surgical intervention with video-assisted thoracoscopic drainage (VATS) and debriement. Recent reports have advocated the VATS a first-line intervention,⁵⁻⁸ while opponents of early surgery maintain that many children who undergo early decortication would get better with chest tube drainage alone. However, adequate drainage and effective antibiotic therapy are still the mainstays of successful treatment protocols. In view of such conflicting reports, we decided to retrospectively review our data of the outcome of post-
pneumonic empyema in children managed in our institute over last seven years.

**MATERIALS AND METHODS**

The medical records of children admitted in Government Medical College, Nagpur, with the diagnosis of post-pneumonic thoracic empyema from January 2009 to November 2015 were reviewed. The review included all children below 12 years of age diagnosed with post-pneumonic thoracic empyema and excluded all patients with other causes of empyema including tuberculosis, patients with chest tube drainage or any surgical intervention done before admission. A total of 124 paediatric patients of post-pneumonic thoracic empyema were treated during this period. Of these, 105 patients satisfying inclusion and exclusion criteria were included for review. The diagnosis of empyema was based on the presence of pleural effusion on clinical and radiological examination and aspiration of purulent fluid from the thoracic cavity. Empyema was defined as pleural effusion demonstrated by chest radiography or ultrasonography, which contained a White Blood Cell (WBC) count 1000/mL or from which an organism could be cultured.

A data was collected regarding age, sex, presenting symptoms and signs, duration of symptoms and previous medication. Findings of radiological investigations like chest x-ray, ultrasonography of the chest and contrast CT thorax were noted. Empyema fluid was studied for gross examination, leukocyte count, glucose, Lactate Dehydrogenase (LDH) levels, protein and culture and sensitivity. Routine laboratory studies included haemoglobin, total leucocyte counts, platelet counts, differential counts, C-reactive protein and ESR, baseline kidney function tests and electrolytes.

Treatment protocol followed included supportive treatment with injectable antibiotics cefotaxime and amikacin as first line antibiotics in appropriate doses and antipyretics. Subsequently, the antibiotic management was determined by clinical progress and pus culture reports. In case of clinical non-response to initial antibiotic therapy after five days of effective drainage and in the absence of a positive culture report, the second line antibiotics used were piperacillin-tazobactam and vancomycin. Antibiotics were given for 4 weeks or longer (if required). Injectable antibiotics were given for a minimum of 2 weeks or till 1 week after disappearance of fever, whichever was later. Empyema was drained under local anaesthesia with a chest tube of appropriate size after admission. The chest tube was inserted in fourth or fifth intercostal space in mid-axillary line. In presence of loculations, chest tube was put under sonographic guidance. A chest x-ray was obtained after 6 hours of insertion of chest tube to confirm position of chest tube.

All patients were assessed for clinical improvement. Daily assessment of the amount of pus drainage, any air leak and the presence of column movement in intercostal drainage tube was noted. Chest tube removal was planned when patient remained afebrile for 72 hours and chest tube drainage ceased to less than 50 cc of clear fluid. Patients were discharged once they became asymptomatic and chest tube was removed. However, they were continued on injectable antibiotics to complete 2 weeks course.

In case of non-response, repeat haematological investigations were done. Continued sepsis indicated by fever spikes, increase in total leucocyte counts, despite antibiotics as per culture-sensitivity reports and intercostal drainage were considered as failure of conservative management and were considered as candidates for surgical intervention after computed tomography of the chest.

Patients were followed at 2 weeks, 6 weeks and 3 months after discharge. They were assessed for any symptoms and clinical findings. Follow up chest x-ray was done at 2 weeks, 3 months, 6 months and in between depending on patients’ condition.

**RESULTS**

A total of 105 patients (65 males, 45 females) diagnosed as post-pneumonic empyema were evaluated. All patients were between 9 months and 12 years of age with a mean of 4.92±1.53 years. The peak incidence was in the 3-6 year old age group. There was a male preponderance of 1.4:1.65 (62%) patients were directly admitted to our hospital. The rest of the patients had initially been treated at another centre and transferred to our hospital afterwards. A mean duration between onset of symptoms and hospitalisation was 9.32±1.68 days. Fever and cough were the main symptoms and a decreased breath sound on the affected side was the most frequent finding on physical examination.

The WBC counts were >15,000 in 71.12% of the patients and elevated levels of ESR and CRP were present in 94.5% and 95.8% of the patients, respectively. Examination of pleural fluid revealed frank pus in 84.38%. Pleural fluid sugars were less than 40 mg/dL in 86.23% samples. Protein and LDH levels of the pleural fluids were 4.85±0.75 g/dL and 2980±767.5 IU/L, respectively. Bacterial growth was observed in only 29 patients (27.6%). Staphylococcus aureus was isolated in 15 patients. Details of microbial results are shown in Table 2.

The chest radiograph at admission showed right-sided collections in 58 patients, left-sided in 41 patients and bilateral 6 patients (blunting of angles on one side in 4 patients). The ultrasonography done in 82 patients at admission showed non-loculated collection in 63 patients (77%), loculated collections in 19 patients (23%) and pleural thickening in 35 patients (43%). All 23 patients who were referred with computerised tomography of chest showed loculated collections, collapse and pleural thickening. Thus, in present study, radiologically, 60% patients presented in fibropurulent stage without loculations while 40% patients had loculations.

Sixty seven (64%) showed clinical improvement after the start of antibiotics and insertion of chest tube. In most patients (62%), fever and respiratory distress subsided within 5 days after admission. Thirty eight (36%) patients required the second line antibiotics after five days of admission. Seventy six (72.3%) patients received antibiotics.
for 4 weeks and 22% for a period greater than 6 weeks. Chest tubes were left in place for between 4 and 35 days with a mean of 8.9±5.8 days. The length of hospitalisation ranged from 6 to 42 days with a mean of 12.3±6.0 days. Twelve patients had bronchopleural fistula. In these patients, the range of hospital stay was 22 to 42 days with a mean of 26±7.36 days. All patients with bronchopleural fistula were managed conservatively and recovered subsequently in next 6 weeks. Three patients had continued pleural pathology were manifested clinically with sepsis even after 5 days of second line antibiotics. These patients had loculations on initial imaging. They were managed by open thoracotomy and decortications after CECT thorax. All these patients recovered well after surgery. The relationship between presence of loculations and need for surgical intervention was not statistically significant (p value - 0.227273; p<0.05). The mean duration of hospital stay in this group was 21 days. If the patients with bronchopleural fistula and surgical intervention were excluded from analysis, the mean duration of chest tube drainage in remaining patients was 6.8±1.9 days while duration of hospital stay was 10.3±2.4 days. Table 3 shows the correlation between patient groups and chest tube drainage and hospital stay. Those patients who were discharged earlier than 14 days had completed the course of injectable antibiotics from home.

All patients improved with treatment and were clinically asymptomatic at discharge. There was no mortality in this study. At follow up, all patients were asymptomatic for their illness. Pleural thickening was noted in 92% subjects and overcrowding of ribs was present in 36% of patients on chest radiograph at discharge. All patients had normal x-ray chest at 3-month follow up.

<table>
<thead>
<tr>
<th>Treatment Modalities</th>
<th>Number of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First line antibiotics with tube thoracostomy</td>
<td>67 (63.8%)</td>
</tr>
<tr>
<td>Second line antibiotics with tube thoracostomy</td>
<td>35 (33.3%)</td>
</tr>
<tr>
<td>Decortication</td>
<td>3 (2.8%)</td>
</tr>
</tbody>
</table>

Table 1. Treatment Modalities Received by the Patients

<table>
<thead>
<tr>
<th>Organism</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No growth</td>
<td>76</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>15</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>08</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>02</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>02</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>01</td>
</tr>
<tr>
<td>Staphylococcus epidermidis</td>
<td>01</td>
</tr>
</tbody>
</table>

Table 2. Pleural Culture Results

<table>
<thead>
<tr>
<th>Patient Groups</th>
<th>Number of Patients</th>
<th>Duration of Chest Tube Drainage</th>
<th>Duration of Hospitalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients without bronchopleural fistula</td>
<td>90</td>
<td>6.8±1.9 days</td>
<td>10.3±2.4 days</td>
</tr>
<tr>
<td>Patients with bronchopleural fistula</td>
<td>12</td>
<td>22.5±6.22 days</td>
<td>26±7.36 days</td>
</tr>
<tr>
<td>Patients with decortications (after surgery)</td>
<td>03</td>
<td>8±1 days</td>
<td>11±1 days</td>
</tr>
</tbody>
</table>

Table 3. Duration of Hospital Stay According to Patient Groups

DISCUSSION
Empyema remains a relatively common problem in the paediatric population with significant morbidity, but negligible mortality with adequate treatment. The optimum management of paediatric empyema is constant source of dilemma to paediatricians, pulmonologists and paediatric surgeons despite of advances in medical and surgical management and the availability of various treatment options in armamentarium. One of the reasons for this is lack of evidence from clinical trials. Three decades ago, Mayo summarised the aims of treatment in paediatric empyema as elimination of the empyema, re-expansion of the trapped lung, restoration of thoracic wall and diaphragmatic mobility, recovery of respiratory functions and decrease in the length of hospital stay. Over last two decades, many treatment modalities have evolved to achieve these goals with an aim to reduce invasiveness of therapy, morbidity and hospital stay. Intravenous antibiotics with or without empyema drainage, mini-thoracotomy and thoracotomy with decortication forms the traditional ways to manage such patients while intrathoracic instillations of fibrinolytics and thoracoscopic drainage are the newer treatment options. But, the indications and optimal timing of these newer therapies remain unclear. Some studies strongly advocate nonoperative treatment while others suggest newer technologies and still others suggest that early open operative drainage is the best choice. Our data suggest that paediatric patients with fibropurulent empyema are likely to experience complete resolution with antibiotics in combination with thoracic drainage. In our study, nearly 40% patients in fibropurulent stage had loculations. Of these, 93% patients were successfully treated with antibiotics and tube drainage. Surgical decortication was required in three patients. These three patients showed loculations on initial imaging. Hence, presence of loculi increases the risk of thoracotomy and decortications, but is not statistically significant. Loculations in early stages of empyema are fibrous and with the
control of disease with proper antibiotics, we feel that fibrinolytic system of our body clears the fibrous loculi. Factors like the duration of symptoms, host resistance, virulence of the infecting organism and the time of initiation of medical management are known to affect the outcome.

It is the fibropurulent group that may benefit the most from the newer therapies. Few authors have recommended the early use of VATS with some advocating it as a first line intervention.6-8 The advantages of early VATS and pleural debridement are ease of procedure, reduced hospital stay and morbidity. The problem with this procedure is- it needs general anaesthesia and there is a controversy over patient selection and timing of surgical intervention. Also, the randomised controlled trials have not shown any advantage of thoroscopic drainage over chest tubes with fibrinolytics.16,17 Our findings clearly indicate that fibropurulent empyemas that respond to chest tube drainage do not require more aggressive surgical treatment. One of the reasons for prolonged hospital stay is intravenous antibiotics. We followed the practice of early discharge (after chest drain is removed and patient becomes asymptomatic) and outpatient intravenous antibiotics that reduces hospital stay. Various authors found normal respiratory function in most of the patients in follow-up period of up to 18 months whether treated surgically or not.18,19 We observed a total resolution of the clinical and radiological findings within 3-6 months and this finding was supported by the other reports.20 Thus, empyema can be reversed completely, both functionally and radiologically.

11% patient in our study had bronchopleural fistula. More commonly, it is a complication of necrotising pneumonia. Management of this subset is frustrating for clinician. In our study, we did not find any specific factors that led to bronchopleural fistula. Positive pus culture was found in one-fourth of these patients. The organisms isolated were Staphylococcus aureus, Streptococcus pneumoniae and Pseudomonas aeruginosa. Though, all patients were successfully managed without surgery, prolonged hospital stay was seen in all patients.

In developing countries where prioritisation of surgeries is needed due to high patient load and limited manpower and resources, paediatric post-pneumonic empyema can be managed with antibiotics with chest tube drainage. The other advantages of newer strategies like decrease in hospitalisation costs can be met with the strategies like outpatient intravenous antibiotics. However, we feel that the regional epidemiological factors of community-based pneumonia maybe responsible to determine the final outcome of post-pneumonic empyema. Randomised multicentre study is the only way to establish the optimal treatment of empyema in children.

**CONCLUSION**

The majority of post-pneumonic thoracic empyema cases in children can be successfully treated with a conservative approach.

**REFERENCES**


