

Empyema Thoracis in Children: A Short Term Outcome Study

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This study prospectively evaluates clinical course of pyogenic empyema thoracis in 25 children (2 mo – 12 y) treated with injectable antibiotics and chest tube drainage, and followed for 6 weeks. The median (range) age at presentation was 3 y (4 mo to 11 y). The pleural fluid culture was positive in 24% of patients. *Staphylococcus aureus* was the most commonly isolated organism. The median (range) duration of injectable antibiotics was 14(14-52) d; median duration of total antibiotics (injectable and oral) was 4 weeks. The median (range) duration of chest tube insertion and hospital stay was 8(5-45) and 14(14-56) days, respectively. All patients were discharged without any surgical intervention besides chest tube drainage. At discharge, pleural thickening was present in 84% and crowding of ribs was seen in 60% of the subjects on radiological examination. All these patients were asymptomatic at discharge. Chest deformity was present in 20% of the patients at 6-weeks follow up. Antibiotics and chest tube drainage is an effective method of treating pyogenic empyema thoracis in children in resource-poor settings.

Keywords: Chest tube drainage, Child, Outcome, Empyema thoracis, Pleural effusion.

Empyema thoracis, a common condition in children [1,2] and has significant morbidity and mortality. The aim of therapy is to ensure rapid recovery with a normal long-term pulmonary outcome. Medical therapy includes use of antibiotics and chest tube drainage. More recently, early intervention in the form of Video-assisted thoracoscopic surgery (VATS) has been reported, A meta-analysis of operative *versus* non-operative interventions for pediatric empyema thoracis has concluded that primary operative therapy is associated with lower mortality, shorter hospital stay, shorter duration of antibiotic therapy, and decreases reinterventions [3]. However, the same review also reported a high cure rate (76%) for conservative management indicating a stepwise approach in the management of pediatric empyema. Primary fibrinolytic therapy, though successful, is associated with a higher risk of complications [3]. However, the local availability and cost, particularly in the case of surgical technique such as VATS, limits the surgical options.

Most of the reported data on pediatric empyema from our country is retrospective, indicating the need for properly designed prospective studies [4-5]. This prospective study aimed to look at the outcome of empyema using a standard protocol of antibiotics and effective chest tube drainage.

METHODS

This was a prospective observational study, conducted in the Department of Pediatrics at our institution from February 1, 2008 to 31 January, 2009. The study was approved by the Institute's ethical committee and written informed consent was obtained from all participants. All children in age group of 2 months to 12 years diagnosed with pyogenic empyema during the study period were included in the study. Patients with prior chest tube drainage or any surgical intervention done before admission were excluded. The diagnostic criteria for empyema thoracis was presence of pleural effusion on clinical and radiological examination, and aspiration of pus from the thoracic cavity.

All patients suspected of pleural effusion clinically were subjected to chest X-ray and, if required, sonography of the chest. All patients were subject to pleural fluid aspiration; ultra sound guided, if required. The fluid thus obtained was subjected to gross examination, cytology (total and differential cell count), biochemistry (sugar and protein), gram/AFB stain and bacterial culture. The culture samples were plated on blood agar, chocolate agar and MacKonkey agar. Results were obtained within 72 hours. Hematological investigations (hemoglobin, total leucocyte counts, differential counts and ESR), baseline kidney function

tests, and electrolytes were done in all subjects. A chest radiograph (AP or PA), and a lateral view, if indicated, were done after chest tube insertion. An echocardiography was done for all patients to identify pericardial effusion.

All patients received supportive treatment, and were empirically administered ceftriaxone, cloxacillin and amikacin as first line antibiotics in appropriate doses. The patients who had received appropriate injectable antibiotics prior to admission were continued on the same. Subsequent management, including choice and duration of antibiotics was determined by clinical progress of the subject and availability of pus culture results. The decision to change antibiotics was taken by the treating physician. In the absence of a positive culture report, the second line antibiotics used were piperacillin-tazobactam and vancomycin. Change of antibiotics was considered in case of clinical non-improvement after five days of initial antibiotic therapy and effective drainage. Clinical non-improvement was defined as persistence of sepsis indicated by fever spikes, poor oral intake and rising total leucocyte counts. Antibiotics were given for 4 weeks or longer (if required); a minimum of 2 weeks of injectable antibiotics or till 1 week after disappearance of fever, whichever was later.

Closed chest tube drainage was carried out (ultrasound guided, if required) by a pediatric surgeon under local anesthesia with a straight chest tube of appropriate size, inserted in fourth or fifth intercostal space (mid-axillary line, safety triangle) attached to a water-seal system. Daily assessment of the amount of drainage/bubbling and the presence of respiratory swing was documented on a chart designed for the purpose. A chest X-ray was obtained after insertion of chest tube to confirm position of chest tube. The chest tube was replaced or repositioned by a pediatric surgeon, whenever required to provide effective drainage. In case of non-response, repeat hematological investigations were done. Continued sepsis indicated by fever spikes, rising total counts, poor oral intake despite antibiotics as per culture-sensitivity reports, and intercostal drainage needed a review of treatment strategy and these patients underwent tomography of the chest and were considered for surgical intervention. The chest tube was removed when there was no drain or minimal drain (<20 ml/day) for two consecutive days with a patent tube.

The criteria for discharge for all patients were absence of fever for at least one week, chest tube removed, absence of tachypnea, and good oral acceptance. After discharge, all patients were followed

up for a period of at least 6 weeks (visits on 1, 3 and 6 weeks). At each follow up, patients were assessed clinically, and subjected to chest radiograph and sonography of chest. Pleural thickening, if present, was reported by the radiologist.

RESULTS

During the study period, 25 children (17 males) were identified with empyema with a median (range) age at presentation of 3 years (4 months-11 years). 23 were malnourished, and 5 had severe wasting. Fever, dyspnea and cough were the most common (90%) manifestations at admission. Median (range) duration of fever was 12 days (5 days - 3 months).

The pleural fluid aspirated was thick pus in 76%; pleural fluid sugars were less than 40 mg/dL in 72% samples. Pleural fluid culture grew *Staphylococcus aureus* in five children, and *Streptococcus pneumoniae* in one child. Blood culture was positive only for one patient. Twenty one (84%) showed clinical improvement after the start of antibiotics. In most patients (56%) fever subsided within 5 days after admission with a median duration of 4 days. The median duration of respiratory distress during hospital stay was 6 days. Four patients received the second line antibiotics after five days of admission. Seventeen (68%) patients received antibiotics (oral plus parenteral) for 4 weeks and 12% for a period greater than 6 weeks. The median duration of chest tube insertion was 8 days, but three patients had prolonged chest tube drainage (1 showed delayed response while the other 2 developed bronchopleural fistula). Three patients required more than one chest tube in view of loculated effusion. The minimum duration of hospital stay to complete the course of injectable antibiotics was 14 days (**Table I**). Four (16%) of children had a prolonged stay; 2 had delayed response and another 2 bronchopleural fistula. None of the patients

TABLE I OUTCOME OF EMPYEMA THORACIS IN STUDY CHILDREN (N=25)

Duration (d)	No. (%)
<i>Chest tube mention</i>	
<8	17 (68)
8-30 d	5 (20)
>30 d	3 (12)
<i>Hospital stay</i>	
<14 d	15 (60)
14-30 d	6 (24)
>30 d	4 (16)

required any surgical intervention. One patient developed pericardial effusion secondary to empyema (detected on echocardiography) that was minimal in amount and needed no surgical intervention. Two patients who developed bronchopleural fistula were managed conservatively and recovered subsequently in next 6 weeks. All patients improved with treatment and were discharged.

The chest radiograph at admission showed unilateral effusions in all subjects, the ultrasonography done within 72 hours of admission showed organized fluid in 28%, loculations in 24% and pleural thickening in 8% patients. Only one child had an underlying consolidation. The computerised tomography of chest was done for only three patients, and it showed loculation, collapse and pleural thickening in all, and underlying consolidation in one patient.

All patients were clinically asymptomatic at discharge. Pleural thickening was noted in 84% subjects and overcrowding of ribs was present in 60% of patients on chest radiograph at discharge (**Table II**). On clinical examination at 6 weeks follow up, chest deformity was evident in 5 (20%) patients and 19 (76%) patients were absolutely normal. One child died at home before the last follow up due to unexplained reasons.

DISCUSSION

This prospective observation study of empyema thoracis in children at a tertiary center found good pulmonary outcome with conservative therapy. It is more common in younger patients, as also seen in our study (52% younger than 5 years). A higher incidence of empyema has been reported in undernourished children [8,9] as seen in this study also. Predisposition of malnourished children to recurrent, severe and complicated infections is a known factor.

Many centres use intravenous antibiotics until the child becomes afebrile or at least till the chest tube is

removed, followed by oral antibiotics at discharge (total duration of antibiotics 4-6 weeks). Average duration of antibiotics used in this study was longer than the previously reported studies from developed countries [10, 11]. The reason for this difference could be a higher incidence of staphylococcal infection in our study patients that required a longer duration of treatment as compared to streptococcal and *H. Influenzae* infections. The median duration of chest tube drainage was 8 days and was similar to that reported in the literature [4,10,12]. Shorter periods of chest tube drainage have been reported in subjects that underwent surgical procedures [3, 12].

The median duration of hospital stay was comparable to other studies on conservative management [5,10,11] but was longer than those treated with fibrinolytics, VATS or thoracotomy for obvious reasons [3]. In the present study, all patients responded to conservative management. Previous studies suggest a success rate of 61% - 100% with chest tube drainage and antibiotics [13-15]. A meta-analysis comparing operative and non-operative procedures has also concluded that conservative management leads to recovery in more than 76% of the patients. However, it needs to be emphasised that a less invasive primary operative procedure like fibrinolytic therapy or VATS has the potential to interrupt the progression of empyema, decrease the pain and discomfort associated with prolonged thoracostomy tube usage and reduce the total duration of hospital stay [3]. Further, the role of these interventions is better defined in patients with loculations within the pleural cavity. About 24% of our patients too had loculations at presentation and this could have contributed to prolonged hospital stay in the study.

The study showed a good pleural recovery in children. Few studies have emphasized on radiological follow up in children in the past [10,13]. Satish, *et al.* [10] reported all patients having marked pleural

TABLE II RADIOLOGICAL FINDINGS AT ADMISSION AND FOLLOW-UP, No. (%)

<i>X ray findings</i>	<i>Admission</i>	<i>Discharge</i>	<i>1 week follow-up</i>	<i>3 week follow-up</i>	<i>6 weeks follow-up</i>
Pleural effusion	25 (100)	0	0	0	0
Pyopneumothorax	4 (16)	0	0	0	0
Clear lung fields	0	1 (4)	2 (8)	3 (12)	13 (52)
Pleural thickening	0	21 (84)	20 (80)	20 (80)	11 (44)
Mediastinal shift	15 (60)	4 (16)	3 (12)	1 (4)	1 (4)
Overcrowding of ribs	4 (16)	15 (60)	15 (60)	11 (44)	8 (32)
Scoliosis	0	4(16)	3(12)	3(12)	2 (8)

WHAT THIS STUDY ADDS?

- Children have good chances of pleural recovery on conservative management alone.

thickening at the time of discharge and 12 out of 14 (85.8%) subjects with scoliosis detected on the chest radiography. These resolved in all children without further intervention in 2 -16 months time. However, in the present study, complete pleural recovery could not be documented due to a shorter period of follow up and was a major limitation. Moreover, spirometry could not be done for a majority of the subjects because of a younger age, and was a limitation. The major strengths of the study were its prospective nature, a standard and uniform protocol of antibiotic usage, and prompt and effective chest tube drainage.

While patients treated with surgical treatment may have shorter duration of chest tube insertion and hospital stay, the availability of local resources and clinical skills for VATS, availability of surgeon and particularly its cost limits its applicability. Moreover, VATS or fibrinolytics are useful only if these interventions are done early in the course. Many patients in this study have reported when loculations or adhesions have already been formed. In conclusion, appropriate antibiotics and prompt chest tube drainage is an effective method of treatment of childhood empyema, especially in resource-poor settings. Majority of the patients improve on this conservative management and have good pleural recovery on follow up.

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