

Research Article



Efficacy of Video Assisted Thoracoscopy Surgery as Primary Treatment in Empyema Thoracis in Children

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ABSTRACT

Empyema thoracis in children is a disease of significant morbidity and mortality. In most patients the disease process develops due to lung infection-pneumonia resulting in parapneumonic effusion in the pleural space which is subsequently complicated into empyema (pus in pleural fluid). A combined approach of antibiotics, intercostal chest tube drainage (ICD) and fibrinolytics in case of loculated empyema are usual recommended treatment in empyema. In this prospective observational study 36 paediatric patients having bacterial empyema, attending the paediatric surgery department of Institute of Medical Science and SUM hospital, Bhubaneswar-Odisha, were taken. VATS was performed as primary intervention in all the cases along with proper antibiotics and post operation ICD. All cases were followed up for 12 weeks with continuation of appropriate antibiotics for 3 to 4 weeks post discharge. The most common symptom noted in patients was fever (100%), cough (88.88%), chest pain (80.55%), and breathlessness (77.77%). Common organism isolated in empyema fluid were staphylococci (36.11%), Pneumococci (30.55%), H. Influenza (27.77%) and anaerobes (5.55%). As per staging of empyema, 19 patients had stage-1 and 17 had stage-2 disease. The mean time for ICD removal in stage-1 cases was 4.7 days and for stage-2 was 6.8 days. The mean time of hospital stay for stage-1 diseases was 5.2 days and for stage-2 was 7.1 days. No VATS-related complications or recurrence was found in follow up. Early intervention by VATS in empyema thoracis in children is highly effective in terms of quick drainage of pleural space, early removal of ICD, less duration of hospital stay, and without any post-operative or future complication and recurrence. So VATS as primary treatment in empyema of children is highly recommended.

Keywords: Para pneumonic effusion, empyema, VATS, ICD, fibrinolytics.

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INTRODUCTION

Approximately 25% of patients having bacterial pneumonia require hospitalization¹. About 40% of hospitalized patients diagnosed with bacterial pneumonia have an accompanying pleural effusion (parapneumonic effusion)². Parapneumonic effusions are the most common cause of pleural effusion in children.³ The morbidity and mortality rates in patients with pneumonia and pleural effusions are higher than those in patients with pneumonia alone. All the parapneumonic effusions are not empyema. However, if the fluid is thick and pus is present, the patient has empyema, drainage is likely to be beneficial.⁴ The common pathogens found in empyema are *S. pneumoniae*, *H. influenzae* and *S. aureus*. Rates of *Staphylococcal empyema* has been increased recently and the incidence of anaerobic infection is less in children.⁵ Para pneumonic effusion also occurs in pulmonary tuberculosis, fungal infection and as a consequence of lung abscess and bronchiectasis, those can progress into

empyema. Empyema in children needs prompt diagnosis and treatment because of high incidence of morbidity, mortality and chest wall deformity. American thoracic society (ATS) has described 3 stages of empyema based on the characteristics of the content of the pleural cavity.⁶ Stage-1 (exudative phase), characterized by free flowing empyema fluid. Stage-2 (fibrinopurulent stage), characterized by loculations in the pleura cavity. Stage-3 (organization phase) characterized by granulation tissue (pleural peel) formation in the pleural space ultimately encase the underlying lung parenchyma leading to trapped lung and reduced gas exchange. ATS staging is helpful for decision making in the treatment of empyema. There is no clear cut consensus about the time frame for each stage of empyema and the staging is assumed on the basis of various investigations like chest x-ray, ultrasonography of chest, CT thorax, biochemical and cytological analysis of aspirated pleural fluid. Routine CT thorax is usually avoided in children due to its high radiation effects but may be recommended in stage-3 disease to assess the degree of pleural thickness when a surgical decortication is indicated.

The treatment of empyema involves two separate areas- 1. Selection of appropriate antibiotics, 2. Management of effusion fluid. All the patients with empyema should be treated with proper antibiotics guided by Gram's stain and culture sensitivity of isolated organisms. While most



common method of management of effusion fluid is by intercostal chest tube drainage (ICD), instillation of fibrinolytic agents into the pleural space like Streptokinase/tPA/DNase in case of loculated effusions in order to disrupt the loculi to facilitate better drainage of effusion. While protracted surgery e.g. decortication of pleura is reserved for stage-3 disease. Success rate of such treatment varies from 25 to 75% in different studies^{7, 8}. In present scenario video assisted thoracoscopic surgery (VATS) replaces as primary interventional treatment in empyema because only ICD may not drain effusion fluid completely, fibrinolytics have low recommendation because exact time of its administration is not known and its role in controlling pleural sepsis not clear¹⁶. With VATS the loculi in the pleural space can be disrupted effectively with complete drainage of fluid and the chest tube can be optimally placed⁹. Some patients may need decortication even in absence of any pleural thickening¹⁰. In addition, if the lung is trapped an attempt can be made for decortication.

Gates et al.¹¹ reviewed the literature in 2004 and found that patients treated with VATS or thoracotomy had significantly shorter hospitalizations (9.9 and 10.5 days, respectively) than did patients treated with chest tube only or chest tube plus fibrinolytics (16.4 and 18.9 days, respectively). Early VATS within 48 hours of admission results in significant shorter duration hospital stay than if the VATS is performed later¹². The aim and objective of this study is to evaluate the success of VATS as the primary mode of treatment for bacterial empyema thoracis in children.

METHODS

This was a prospective observational study conducted in the department of paediatric surgery of Institute of Medical Science and SUM Hospital, Bhubaneswar, Odisha, in which 36 number of paediatric patients attending the department over a period of 4 year (March 2017 to February 2021) having bacterial empyemathorac is proved by culture, were taken in this study.

Inclusion criteria:

1. Age of patient- 1 month to 14 years with diagnosis of empyema.
2. Empyema fluid shows culture positive for pyogenic organisms.

Exclusion criteria:

1. Empyema associated with lung abscess and bronchiectasis as it was not possible to achieve effective clearance thoracoscopically.
2. Long standing empyema cases of more than 2 weeks with pleural organization and fibrosis (stage-3), as they need more devastating surgery like decortication.
3. Empyema due to other causes like Tuberculosis, fungus, traumatic, sub phrenic abscess,

peritonitis etc. as those conditions need other specific treatment.

All patients were subjected to thorough clinical examination, routine blood investigations like complete blood count (CBC), chest x-ray, ultrasonography of chest, diagnostic pleural fluid aspiration (under ultra-sonogram guided when necessary) for biochemical test like protein, sugar, LDH and cytological test, Gram's stain, culture and sensitivity test for pyogenic organism. Sputum and pleural fluid samples were examined microscopically along with cartridge based nucleic acid amplification test (CBNAAT) in each case to exclude tubercular cause of empyema. VATS was carried out in general anesthesia in all the cases as initial mode of treatment by a paediatric surgeon. Drainage of effusion fluid and disruption of loculi in pleural space was done effectively in each patient. Intercostal chest tube drainage (ICD) was put in all the cases after the VATS operation. All the cases were treated with proper antibiotics during the hospital stay and for 3 to 4 weeks post discharge. The criteria for discharge for the patients were absence of fever for at least 3 consecutive days, removal of ICD after nil fluid collection via chest tube or collection of less than 50 ml of yellowish color fluid in last 24 hours, and good oral intake. After discharge all patients were followed up for a total period of 12 weeks like at the end of 1, 3, 6, 9 and 12 weeks. At each follow up patients were assessed clinically, with chest x-ray and ultrasonographically. The parameters studied include age and sex distribution, duration of symptoms, radiological and ultra-sonogram findings, biochemical and cytological results, Gram stain along with culture and sensitivity reports. The outcomes measured were in terms of total duration of intercostal chest tube drainage and hospital stay, recurrence of empyema, VATS related complication if any and mortality.

RESULTS

Out of total 36 patients in this study, 23, 8, and 5 patients were in the age group of >5, 5-9, and 10-14 years respectively (Table 1). Total number of male children were 20 and female children were 16. Right sided empyema was present in 26 and left side was in 10 children (Table 2).

Table 1: Age distribution

Age group in years	No. of cases	%
<5 years	23	63.88
5-9	8	22.22
10-14	5	13.88
Total	36	100

Table 2: Sex distribution

Sex	No. of cases	%
Male	20	55.55
Female	16	44.44
Total	36	100



Regarding clinical presentation, fever was commonest symptom in all patients (100%), followed by cough in 32 (88.88%), chest pain in 29 (80.55%) and breathlessness in 28 (77.77%) patients. Common organisms isolated in empyema sample were *Staph. Aureus* in 13 (36.11%), *H. Influenza* in 11 (30.55%), *S. Pneumoni* in 10 (27.7%), and anaerobes in 2(5.55%) cases. Regarding empyema staging 19 patients had stage-1 disease including one case with bronchopleural fistula and 17 had stage-2 disease (Table 3,4). The mean time for ICD removal in stage-1 cases was 4.7 days with standard deviation (SD-1.2) and in stage-2 was 6.8 days (SD-1.4). The mean duration of hospital stay in stage-1 diseases was 5.2 (SD-0.8) days and in stage-2 was 7.1 (SD-1.2) days.

Table 3: Clinical symptoms distribution

Symptoms	No. of cases	%
Fever	36	100
Cough	32	88.88
Chest pain	29	80.55
Breathlessness	28	77.77

Table 4. Organism distribution in empyema cases

Organisms found in culture	No. of cases	%
<i>Staph. Aureus</i>	13	36.11
<i>H. Influenza</i>	11	30.55
<i>Str. Pneumoni</i>	10	27.77
<i>Pseudomonas</i>	2	5.55

Average duration of hospital stay for all patients was 5-7 days. One case with bronchopleural fistula was healed up by 2 weeks spontaneously. Complete resolution of empyema occurred by 3 weeks in all patients. There was no post-operative complication in any patient. No patient had any recurrence or complication during follow up.

DISCUSSION

Empyema Thoracis remains as a significant health problem in children in developing countries like India due to low socioeconomic status, malnutrition, delayed presentation by the patient at proper health care facility, delay in diagnosis of pneumonia and delayed referral to higher center. Prompt diagnosis, early drainage of pleural space, appropriate antibiotics and lung expansion are the mainstay in the treatment of empyema. However there is no clear consensus on the best way to obtain these objectives. In our study the age of presentation and male predominance was consistent with other similar studies^{13, 14}. The high prevalence was found in under-fives. The incidence of common symptoms at admission like fever, cough, chest pain and breathlessness were similar to many other studies.^{14, 15} The conventional treatment of early empyema with ICD and Fibrinolytics combinations remains in controversy. Early VATS intervention has highest success rate, 100% in our study with advantages like shorter

duration pleural drainage by ICD, shorter hospital stay and for which may be responsible for lower cost of treatment in comparison to ICD alone or ICD + fibrinolytics that makes treatment duration prolonged. Some other study indicated nil recommendation of fibrinolytic agents because exact time of administration for lysis of loculations septae and definite role in controlling of pleural sepsis is not clear,¹⁶ and they are costly too.

CONCLUSION

Unlike adults, empyema in children have favorable long term outcomes due to absence of any underlying chronic lung pathology. VATS as a primary treatment strategy is associated with highest efficacy due to shorter duration for ICD, shorter duration of hospital stay, complete resolution of empyema and may be a low cost treatment for bacterial empyema in children.

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