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Original Research Article

Paediatric empyema: video-assisted thoracoscopic surgery (vats) and its outcome study

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ABSTRACT

Background: Empyema thoracis defined as purulent pleural effusion is a common condition in children with significant morbidity and mortality. The aim of therapy for empyema is to ensure rapid recovery with a normal long term pulmonary outcome. VATS (Video-assisted thoracoscopic surgery) is gaining acceptance as a primary modality of treatment in cases of early empyema. VATS is associated with decreased morbidity and reduced hospital stay of the patient.
Methods: This is a retrospective observational study conducted in the department of pediatrics KIMS Hospital, Bengaluru from November 2014 to November 2016. In this study, review of the medical records of all the children aged 2 months to 18 years, who underwent VATS for empyema was done. The children included in the study were diagnosed with empyema thoracis based on chest X- ray, USG chest and CT chest and have undergone VATS by pediatric surgical team.
Results: Most common symptoms were fever (96%), cough (84%), respiratory distress (61%) and chest pain (48%). All patients had parapneumonic effusions and received antibiotics before undergoing surgery. Post-operative supplemental oxygen was required for 2.5±0.5 days. Chest tubes were removed in 4.53±0.7days and duration of stay in hospital was 8.26±1.77 days. All patients were afebrile before discharge and were discharged on oral antibiotics.
Conclusions: These results suggest that primary operative therapy in the form of VATS is an effective treatment option for children with empyema. VATS is associated with a lower in-hospital mortality rate, re-intervention rate, length of stay and duration of tube thoracostomy.

Keywords: Empyema Thoracis, VATS

INTRODUCTION

Empyema thoracis, defined as purulent pleural effusion is a common condition in children with significant morbidity and mortality.[1-3] The most common cause for empyema thoracis is parapneumonic consolidation (a complication of bacterial pneumonia). Infection of the pleural space occurs either from direct bacterial spread across visceral pleura or by free intra-pleural rupture of peripherally located lung abscesses. Along with bacteria, neutrophil (not normally located in pleural space) count of the pleural fluid increases, leading to an increase in multiple chemotactic factors and activation of the coagulation cascade and raise in procoagulant factors. The resultant higher procoagulant activity in the pleural fluid leads to fibrin deposition within the pleural space and formation of septations and loculations.

Empyema usually presents with persistent high grade fever, cough, tachypnea / dyspnea, irritability and chest deformity. Malnourishment and wasting are associated. Empyema has classically been divided into 3 stages which follow the progression of their pathogenesis.[3]

- *Stage 1 (exudative phase):* Pleural membranes swell considerably and thin exudative fluid leaks into the pleural space (simple parapneumonic effusion).
- *Stage 2 (fibropurulent phase):* There is deposition of fibrin leading to septation and loculations with an increase in white cells and fluid thickness (complicated parapneumonic effusion) and ultimately frank pus (empyema).
- *Stage 3 (organizing phase):* Massive influx of fibroblast activity leads to formation of collagen fibers over visceral and parietal pleura, with development of a thick pleural peel that prevents lung re-expansion.

Patients often present with shortness of breath, dyspnea, fever and cough. With increasing inflammation the patient may experience pleuritic chest pain and possibly abdominal pain and vomiting. 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 with primary operative therapy in form of VATS (video-assisted thoracoscopic surgery) has been reported to have better outcomes. 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 decreased reintervention.[4]

This retrospective study is aimed to look at the outcome of empyema after primary operative therapy (VATS).

METHODS

This is a retrospective observational study conducted in the department of pediatrics KIMS Hospital, Bengaluru from November 2014 to November 2016. In this study review of the medical records of all the children aged 2 months to 18 years, who underwent VATS for empyema was done. The children included in the study were diagnosed with empyema thoracis based on chest X- ray, USG chest and CT chest and have undergone VATS by pediatric surgical team. Patients with prior chest tube drainage or any surgical intervention done before admission were excluded from the study.

Thoracentesis and pleural fluid analysis was done in all patients. The fluid obtained was subjected to gross examination cytology (total and differential cell count) biochemistry (sugars and proton), gram/AFB stain and bacterial culture. Hematological investigations (hemoglobin, total leukocyte counts, differential counts and ESR), RFT, LFT, electrolytes were done in all subjects. Blood cultures were done and results obtained within 72hrs.

All the patients received supportive treatments and were treated empirically with antibiotics. Duration of antibiotics was determined by clinical progress of subject. Pus culture and blood culture results helped with changing to appropriate antibiotics in cases that showed no improvement after 5 days of empirical antibiotic therapy and effective drainage.

VATS procedure

All procedures were performed by the same pediatric surgical team. General anesthesia with single lumen endotracheal intubation was employed in all cases, post intubation the patent was positioned in full lateral decubitus position. The first thoracoscopic port was placed either in 5th or 6th intercostal space in mid axillary line. 30° thoracoscope was introduced through the first port and thoracic cavity inspected the remaining ports were placed under direct vision depending upon the area of interest.

VATS decortication

In most of the cases 2 ports were used. After port placement the fibrinous exudates and purulent collection were evacuated and specimens were sent for biochemical examination, bacterial smear and culture. The fibrinous peel over the lungs was excised. Once the fibrinous peel excised and the underlying lung was expanding well, wash was given with normal saline. The port sites were closed after placing appropriate intercostal drain.

Post operatively all the children were shifted to PICU for monitoring. The children were given adequate pain relief with NSAID's. Chest physiotherapy was started as early as post-operative day 2. X-ray was done for every patient 6hrs post-surgery to look for expansion of lung.

The criteria for discharge for all patients were absence of fever for at least 5 days, chest tube removed, absence of tachypnea, and good oral acceptance. Patients were followed up for at least 6 wks after discharge.

RESULTS

26 children with empyema were treated with VATS, median age of presentation was 4.1 yrs. 18 children were malnourished of which 3 had severe malnutrition. The male to female ratio was 1:1 with both males and females being 13 in number. Most common symptoms were fever (96%), cough (84%), respiratory distress (61%) and chest pain (48%). All patients had parapneumonic effusions and received antibiotics before undergoing surgery. Pleural fluid sugars were 39.5±4.8mg/dl, total counts were elevated in 100% samples with a mean of 16,791±4,571 and pH showed a mean of 6.89 (Table 1). Pleural fluid cultures showed no growth. Blood culture was positive in 1 case which grew *Staphylococcus aureus*.

Operative time was around 90 mins to 120 mins. 5 specimens were positive for tubercular etiology. Rest were consistent with inflammatory tissue empyema. 1

case required postoperative ventilation for > 24hrs. All cases were shifted to Pediatric Intensive care unit for postoperative monitoring for 1-2 days.

Table 1: Outcome of vats in children with empyema thoracis.

Age (Median)		**4.1 yrs**
Male/Female		**13/13**
Presenting symptom	Fever	96% (n=25)
	Cough	84% (n=22)
	Dyspnea	61% (n=16)
	Chest pain	54% (n=14)
Pleural-fluid characteristics	Visibly purulent	65% (n=17)
	Positive Gram Stain for bacteria	5
	Mean sugar level	39.5±4.8 mg/dL
	Mean pH	6.89±0.12
Microbiologic characteristics	Positive blood culture	1
	Positive Pre-Op. pleural fluid culture	0
Operative results	Operative time	90-120 mins
	Estimated blood loss	150ml
	Conversion rate	0% (n=0)
	Post-op. Ventilator use(Mean±SD) (hrs)	9.23±5.93
	Post-op. ICU stay(Mean±SD)	1.73±0.53 days
	Resolution of fever(Mean±SD)	2.34±1.38 days
	Chest tube duration(Mean±SD)	4.53±0.7 days
	Air leakage	0
	Postoperative hospital stay(Mean±SD)	8.26±1.77
	Complications	7% (n=2)
	Perioperative mortality	0

Post-operative supplemental oxygen was required for 2.5±0.5 days. Chest tubes were removed in 4.53±0.7days and duration of stay in hospital was 8.26±1.77 days (Table 1). All patients were afebrile before discharge and were discharged on oral antibiotics.

Follow-up data showed that symptoms resolved in 24 children, 2 children had complications, one child had pneumothorax and other had broncho-pleural fistula

DISCUSSION

The principal aim of empyema treatment is to limit sepsis by evacuating and sterilising the pleural cavity, thereby restoring pleural fluid circulation and function.[4] Incomplete drainage of the pleural space will result in persistent infection which would lead to functional impairment and substantial morbidity and mortality. Prompt surgical intervention is necessary to prevent this. However, the decision making for appropriate treatment (surgical and non-surgical) is a vexing clinical problem due to the absence of specific clinical, radiological and laboratory characteristics for appropriate preoperative staging of empyema.[5]

The indications and choice of surgical intervention are largely dependent on local surgical experience, preference, extent of the illness and expertise. There is currently little consensus with regard to the optimal surgical management of childhood empyema. The advent of video-assisted thoracic surgery (VATS) for the management of fibrinopurulent stage II empyema has shown rewarding results in several reports.[6–12] VATS has the advantage to be less invasive than open decortication and to have a better acceptance by the patient.

This retrospective study was done to study the outcomes on VATS done in 26 children with empyema thoracis

In this study we found that empyema was common in undernourished children as was seen in other similar studies.[13,14] We observed that children in this study had good pleural recovery and zero percent mortality and conversion rate due to early intervention with VATS.

In a meta-analysis of 67 studies done by Avansino et al it was observed that Patients who underwent primary operative therapy had a lower aggregate in-hospital mortality rate (0% vs 3.3%), re-intervention rate (2.5% vs 23.5%), length of stay (10.8 vs 20.0 days), duration of tube thoracostomy (4.4 vs 10.6 days), and duration of antibiotic therapy (12.8 vs 21.3 days), compared with patients who underwent non-operative therapy [4]. We found similar findings of aggregate in-hospital mortality rate (0%), re-intervention rate (0%), length of stay (8.26 days), duration of tube thoracostomy (4.53 days) in our study.

Small sample size and retrospective study were the drawbacks of the study.

CONCLUSION

The results suggest that primary operative therapy in the form of VATS is an effective treatment option for children with empyema. VATS is associated with a lower in-hospital mortality rate, re-intervention rate, length of stay and duration of tube thoracostomy.

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