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Research Article

Video Assisted Thoracic Surgery in Fibrino-purulent Empyema

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Keywords

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Abstract

Aim: Thoracoscopy is being used increasingly in Empyema thoracis (ET), in last two decades. We share our single surgeon experience with Video assisted thoracoscopic surgery (VATS), in fibrino-purulent stage (stage 2), of ET in children, especially looking at differences in outcome between necrotizing and non-necrotizing pneumonia.

Methods: A retrospective case note analysis of stage 2 ET managed by primary VATS and debridement by a single surgeon between 2016 and 2019 was done. Patients were divided according to underlying lung pathology into non-necrotizing (NNP), and necrotizing pneumonia (NP). Outcomes analyzed included success rate, duration of intercostal drainage (ICD), length of hospital stay and complications.

Results: Out of 25 children studied, 20 had NNP and 5 had NP. Mean age was 3.7 years. In cases of NNP, the mean duration of ICD, post-intervention stay and IV antibiotics was 3.9, 8.7 and 8.5 days respectively. In cases of NP, the same were 9.3, 15 and 13 days respectively. VATS was successful in 95% of cases in NNP while in cases of NP it was 60%.

Conclusion: Primary VATS and debridement in experienced hands has a high efficacy while reducing the morbidity in empyema with NNP. In children with underlying NP, VATS has with higher failure rate. Accurate identification of NP by radiology or at surgery is important to prognosticate and to plan appropriate treatment.

ABBREVIATIONS

ET: Empyema Thoracis; VATS: Video Assisted Thoracic Surgery; CT: Computerized Tomography

INTRODUCTION

Empyema thoracis (ET), is accumulation of purulent fluid within the pleural cavity. Approximately 1 in every 150 children hospitalized with pneumonia will develop empyema thoracis. It remains a significant health problem throughout the world, more so in the developing countries due to low socioeconomic status, malnutrition, delay in diagnosis and referral to higher centre. The treatment options available in fibrino-purulent stage (Stage 2) of ET are antibiotics with or without thoracentesis, ICD with or without fibrinolytics, VATS and Thoracotomy with debridement [1]. There is no consensus on ideal treatment or on the timing of various interventions available. The choice of surgical intervention thus depends on the local practice of the involved medical personnel. VATS with debridement has been preferred modality by most pediatric surgeons due to faster postoperative recovery, less pain, better cosmoses and shorter hospital stay [2]. We herein describe our experience with primary VATS and debridement and determine its efficacy.

MATERIALS AND METHODS

The database of children with diagnosis of stage 2 (fibrinopurulent), ET secondary to bacterial pneumonia between May 2016 and April 2019 operated under a single pediatric surgeon were retrospectively analyzed. Neonates, tuberculous empyema and empyema due to other pathologies were excluded.

Children were diagnosed as stage 2 ET based on duration of illness and Ultrasound (USG), of thorax. Duration of symptoms of less than 15 days with USG findings showing loculations/septations were considered as children with stage 2 ET.

From a retrospective case note study, the age, sex, side of empyema, duration of symptoms, organism in pleural fluid culture, duration of intravenous antibiotics, duration of intercostal drainage (ICD) tube, duration of hospital stay post intervention, any complications, clinical and radiological resolution were noted.

All children underwent VATS and debridement as primary

treatment. VATS was done by standard three port technique using 5mm ports. All septations were debrided, loculations released and thickened pleura over lung removed as needed to ensure free lung expansion. Necrotic areas of lung were noted, but not disturbed during the procedure to minimize formation of broncho-pleural fistulae. Figure 1 shows the thoracoscopic view of pleural septations and collapsed lung in empyema. Post-operatively, the ICD was removed when child was clinically well, drain output was minimal, with no air leak and chest x-ray showed good lung expansion. Antibiotic choice and duration was guided by the pediatricians.

Necrotizing pneumonia (NP), cases have been analyzed separately. NP was diagnosed by radiological investigation (USG showing cavitation or area of decreased echogenicity within consolidated lung, with poor vascularity on Doppler), or by direct observation during thoracoscopy. We have analyzed our data comparing VATS in non-necrotizing and necrotizing pneumonia with regards to success rate and complications.

Treatment was considered to be successful if the child improved clinically in terms of general condition, fever, respiratory complaints and air entry, along with good lung expansion on x-ray. Treatment was labelled as failure when child had persistent fever spikes or respiratory distress 72 hours after VATS, and/or failure of lung expansion of x-ray.

The number of cases which resolved or which required further modalities of treatment were documented and the data analyzed.

RESULTS

A total of 25 children were included in the study. 20 children were found to have underlying non-necrotizing pneumonia (NNP), and 5 had necrotizing pneumonia (NP).

The mean age was 3.7 years (2months - 12 years). ET was most commonly seen in preschool age group (1- 5 years) accounting for 68 % of cases. Male to female ratio was 1:1.4 with equal incidence on either side. The most common organism grown on pleural fluid culture was Pneumococcus. However, in 40% of cases, there was no growth.

Out of the 20 children with NNP, there was temporary air leak in 2, which settled with conservative management. There was one failure (persistent fever) which required thoracotomy and decortication. Figure 2 (a, b) demonstrate X-ray chest films taken pre and post VATS showing good lung expansion and pleural clearing.

Figure 1 Thoracoscopic view of pleural space in fibrino-purulent stage empyema showing septations and loculations and underlying collapsed lung.

Two children out of 5 with NP developed persistent air leak. One of them recovered without further intervention; however, the other child required thoracotomy with serratus digitation muscle flap cover for broncho-pleural fistula with an uneventful post-operative recovery. One further child with NP required thoracotomy due to persistent fever. Analysis of VATS / debridement revealed success rate of 95% in NNP as compared to 60 % in NP. This is in keeping with the increased morbidity reported in empyema with NP. The parameters analyzed in our study are shown in Table 1. There were no deaths in our series reinforcing the excellent recovery seen in pediatric empyema.

DISCUSSION

ET is the accumulation of pus in pleural cavity seen predominantly in preschool age group. Most common cause of ET in children is bacterial pneumonia, the other causes being tuberculosis, trauma, tumour, esophageal perforation. We have analyzed only cases secondary to pyogenic bacterial pneumonia in our study. In our study, Pneumococcus was the most common causative organism identified though there was no organism identified in pleural fluid in many cases. This may be due to prior antibiotic treatment given at local hospitals.

Pleural infection in pneumonia is divided into three stages i.e., exudative stage, fibrinopurulent stage and organized stage [3]. We have looked at only fibrinopurulent stage in our study, as diagnosed by duration of illness and Ultrasound of chest, which is the key investigation in our study, and computerized tomography (CT), was not done routinely to avoid increased risk of radiation with CT.

The overall aim of treatment in fibrinopurulent stage is to resolve clinical symptoms and prevent further progression of the disease, sterilize pleural cavity, shorten hospital stay and re-expand the lung. This often requires debridement. Debridement can be chemical (fibrinolysis) or mechanical (VATS) [4]. The choice of primary VATS in our study group was based on experience and availability of the pediatric surgeon in consultation with physician. This is line with the many centres and there is an absence of clear institutional guidelines as described by Richards et al in their national survey [5].

Today, VATS is universally preferred over thoracotomy in stage 2 empyema [6]. Primary VATS without preliminary pleural drainage in empyema has further shown to result in shorter duration of ICD, less pain and shorter hospital stay. We have offered primary VATS and debridement. However, in a child presenting with severe distress and a large pleural collection, a preliminary pleural drainage can alleviate the distress and make the anesthesia safer.

Table 2 shows comparison of our study NNP group with other reported studies. Our experience in this group of children is in line with other centres reporting VATS in empyema. The longer hospital stay observed in above table may be in part due

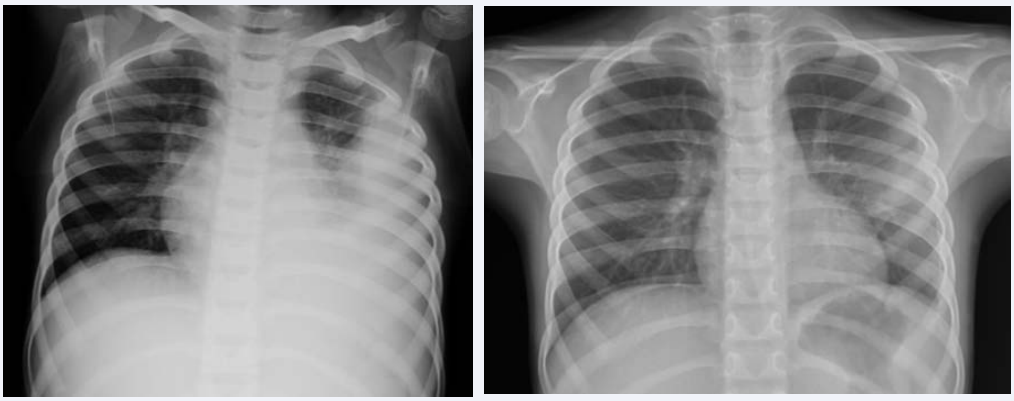

Figure 2 (A) X-ray chest showing left empyema (B) X-ray chest 20 days post-VATS in left empyema. Full lung expansion and complete clearance of pleural opacity seen.

Table 1: Comparison of outcome between empyema with necrotizing and non-necrotizing pneumonia.

Lung status	ICD duration Mean(range)	IV Ab duration Mean (range)	Postop Hosp stay (days) Mean (range)	Success	Failure
NNP (n-20)	3.9 (2-6)	10.80 (8-26)	8.50 (5-17)	19/20	1/20
NP (n-5)	10 (7-17)	13 (12-15)	12.33 (9-19)	3/5	2/5

Abbreviations: ICD: Intercostal Drain; Postop: Postoperatively; Hosp: Hospital; IV Ab: Intravenous Antibiotics; NNP: Non necrotizing Pneumonia; NP: Necrotizing Pneumonia

Table 2: Comparison of outcome after VATS for empyema in published studies.

Author	Number of Patients(n)	Hospital Stay Mean / Median (days)	Mean Duration of ICD Postop(days)
Suchar [7]	42	8	4.1
Gates [8]	6	8.4	NA
Cohen [9]	21	7.4	4
Our study	20	8.5	3.9

Abbreviations: ICD: Intercostal Drain; Postop: Postoperatively

longer period of IV antibiotics given in concurrence with the pediatricians as per antibiotic policy at our institute.

NP encompasses a variety of presentations following necrosis of lung tissue leading to formation of lung abscess, pneumatoceles, associated empyema and broncho-pleural fistula. It is reported to be increasingly seen, complicating 0.8–7% of all cases of community-acquired pneumonia (CAP) and up to 20% of those with empyema admitted to tertiary pediatric hospitals [7-12]. The incidence of NP in our study was 20 % (5 out of 25 patients). Recommendations by Infectious disease society of America (IDSA) and American Pediatric Surgical Association (APSA) are to avoid surgical intervention per se in NP [13,14], as the necrotic lung has a good recovery potential and drainage of the necrotic lung may increase the risk of broncho-pleural fistula. However, in children presenting with extensive associated empyema, either an ICD with fibrinolytics or VATS for drainage of empyema is required. At thoracoscopy we have avoided disturbing the necrotic patch, to minimize the risk of future development of persistent air leaks. In children with persistent air leaks not improving with antibiotics, we would plan to intervene after 10-14 days with serratus digitation flap repair of the fistula. VATS/ debridement for empyema with NP in our hands was associated with re-intervention in 40% (2/5) similar to a study in Portugal [15].

CONCLUSION

The management of empyema thoracis with NNP in the fibrinopurulent stage with early primary VATS has high efficacy, with short duration of ICD, hospital stay and good cosmesis. Empyema with necrotizing pneumonia has higher morbidity and failure rate, as also needing a longer duration of antibiotics and hence accurate identification of this subgroup is key to achieving success.

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