Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

MANAGEMENT OF EMPYEMA THORACIS IN CHILDREN IN COVID ERA

Dr Abhishek Ranjan[1], Dr Vidisa Bose[2], Dr Shyam Sundar Sahu[3], Dr Abhishek Kumar Singh[4], Dr Priya Shalini Lakra[5], Dr Hirendra Birua[6]

[1] MBBS, MS, MCH, Associate Professor, Department of Paediatric Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

[2]MBBS, DNB, Senior Resident, Department of Paediatric Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

[3]MBBS, MS, MCH, Assistant Professor, Department of Paediatric Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

[4]MBBS, DNB, MCH, Assistant Professor, Department of Paediatric Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

[5]MBBS, MS, MCH, Assistant Professor, Department of Paediatric Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

[6]MBBS, MS, MCH, Professor, Department of Paediatric Surgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand

Address for Correspondence

Dr Shyam Sundar Sahu

Email id: drshyamsundarsahu@gmail.com

==========

ABSTRACT

Background: An empyema is the accumulation of purulent fluid in the pleural cavity and complicates pneumonia in 1 of 150 affected children. Symptoms include shortness of breath, fever, dry cough and chest pain.

Aims: To evaluate the management of empyema thoracis in children in the COVID era.

Methods: We retrospectively reviewed all the patients in our Department admitted between December 2020 to May 2023 who were diagnosed with empyema thoracis and surgically intervened.

Results: 22 children with empyema thoracis were treated. All the patients had parapneumonic effusion treated with parenteral antibiotics and chest tube insertion initially but symptoms did not subside. Pre operative imaging included Chest X ray in all the cases and HRCT chest in 16 cases. Four of them underwent Video Assisted Thoracoscopic Surgery (VATS) out of which 2 required conversions to open thoracotomy and 18 patients underwent open thoracotomy primarily. First post operative Chest X Ray was done on POD 1. Chest tubes were removed on post operative day (POD)-4 for VATS and POD 6 for open thoracotomy. One patient treated with VATS and two with Open thoracotomy developed small bronchopleural fistula which was managed conservatively. One patient for whom VATS was converted to open thoracotomy had to undergo prolonged ventilation and expired. Follow up was done for all the discharged patients, all of whom were symptom free and suffered no recurrence.

Conclusion: Early surgical management of empyema thoracis in Pediatric population is warranted for curative treatment with low morbidity.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

INTRODUCTION

An empyema is the accumulation of purulent fluid in the pleural cavity and complicates pneumonia in 1 of 150 affected children.It may also occur following trauma, neoplastic processes, intrathoracic esophageal perforation, or as a complication of intrathoracic surgery.

Even during the ancient times of Hippocrates, Paul of Aegina, and Fabricus, empyema was a known complication that followed pulmonary infections and required external drainage for cure. Until the antibiotic era, discussions of therapy for empyema largely centered on the relative advantages of open drainage, various types of closed drainage, and the optimal time for the use of these measures.[1]

Empyema is the state in which purulent fluid is present in the thoracic cavity. If pleural effusion is purulent, a diagnosis of empyema is given even if a microbial test is not positive. Empyema is associated with high morbidity and mortality. Most causes of empyema are from pneumonia, which often begins with parapneumonic pleural effusion, but the physiology is variable. The number of patients with empyema is increasing in both children and adults. Empyema has a 10–20% mortality rate, long hospital stays, and a heavy financial burden. One third of patients being treated require surgical treatment.[2] It is estimated that 0.6% of childhood pneumonia's progress to empyema, affecting 3.3 per 100000 children.[3]

Incidence of empyema is increasing in spite of various treatment modalities available. We believe poverty, ignorance, malnutrition, prevalence of tuberculosis, delay in initiating treatment or inadequate/inappropriate treatment of bacterial pneumonia, non-evacuation of pleural space and delayed referral might be some factors for its increasing incidence.[4]

This retrospective study is carried out to evaluate the effectiveness of different types of surgical intervention in managing empyema thoracis in children, namely video assisted thoracoscopic surgery vs. open decortications.

MATERIAL AND METHODS

This retrospective study, analyzing the surgical management of empyema thoracis in pediatric patients was performed from December 2020 to May 2023 (30 -month duration) on patients admitted at the Department of Pediatric surgery, Rajendra Institute of Medical Sciences Ranchi, Jharkhand. Children (2-14 years of age) with clinical and radiological evidences of empyema thoracis which did not resolve on IV antibiotics and chest drain insertion were included in the study.

Initially all the patients were admitted in the Pediatric Medicine department where Empyema thoracis was diagnosed by clinical (chest auscultation and percussion), radiological and after aspiration of pus from pleural cavity. Detailed history, clinical examination, necessary hematological investigations , chest X-ray, ultrasonography and if needed HRCT scan of thorax, echocardiography (to detect pericardial effusion) was performed. Diagnostic aspiration was done

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

under radiological guidance and supportive treatment in the form of analgesics, IV fluids , antipyretics, oxygen supplementation and iv antibiotics was given on as per requirement.

ICD insertion was done in patients who had persistent fever or dyspnea even after IV antibiotics for 72 hours. Quantity of drainage, its colour and water column movement was recorded daily. In non-responsive patients' high-resolution CT of thorax was performed to look for loculations, effusion, crowding of ribs, thick pus and pleural thickening on chest X-ray were considered for operative intervention.

Patients who were considered for open decortications or VATS were shifted to pediatric surgery ward and after pre-anesthetic check-up, operative intervention was planned.

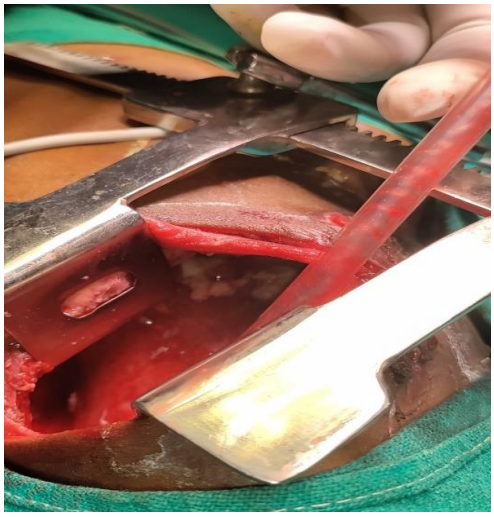
A  B 

Figure 3 (A&B): Intra operative picture of open decortications with visible pus flakes inside thoracic cavity

In open decortication, diseased hemithorax was opened by posterolateral thoracotomy incision without resection of rib. The intrapleural debris, fibrinous tissue and pus was thoroughly evacuated. The thickened visceral pleura was carefully removed thus leading to lung expansion on table. Pleural peel was removed down to diaphragm, excised out taking care of the surrounding neurovascular structures, excised pleura sent for histopathological examination. All significant air leaks were closed with 2-0 prolene. ICD was placed on the operated side and thoracotomy wound closed with vicryl. Intercostal block were given to all patients for post op analgesia. In VATS, adherent peel was removed completely from the pleural surfaces thoracoscopically and pleural space was irrigated with antibiotic solution and a chest tube was placed.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

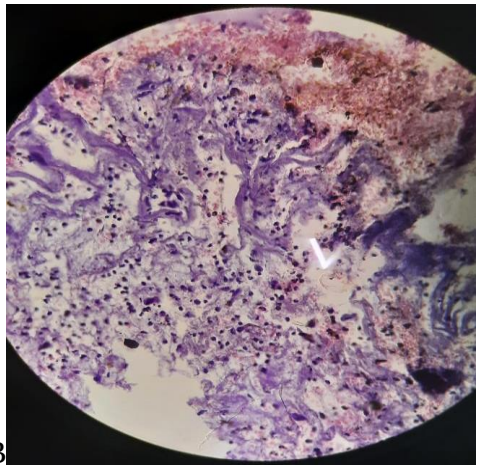
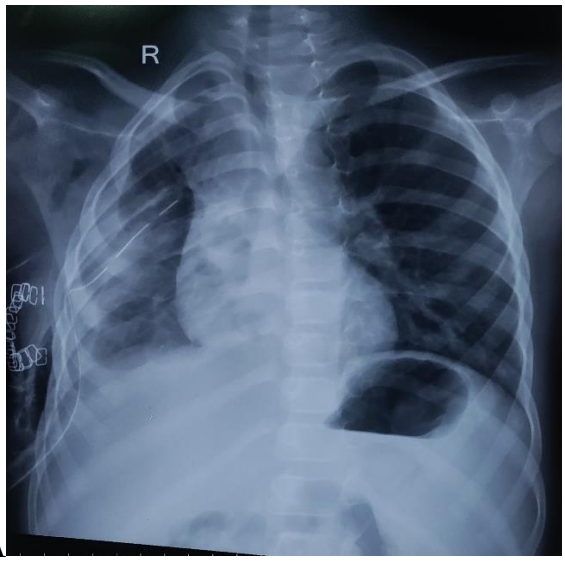
A  B 

Figure 4: (A). Pleural tissue bits sent for HPE. (B) Microscopic view of Empyema Thoracis tissue : hemosiderin laden macrophages and degenerated neutrophil and lymphocytes

The post operative care included care of thoracotomy wound, chest drain care, chest physiotherapy and monitoring of vitals. Chest X-ray was done in POD 1 to see the status of lung expansion and residual collection, if any. Patients were started on incentive spirometry (those children who can do it) as early as possible along with nursing in an upright position. Postoperative chest tubes were kept till POD 4 for VATS and till POD 6 for open decortications and serial observations were made. Outcomes of various procedures were evaluated. Patients were followed up at 3 months and 6 months or more frequently in the presence of symptoms.

A 

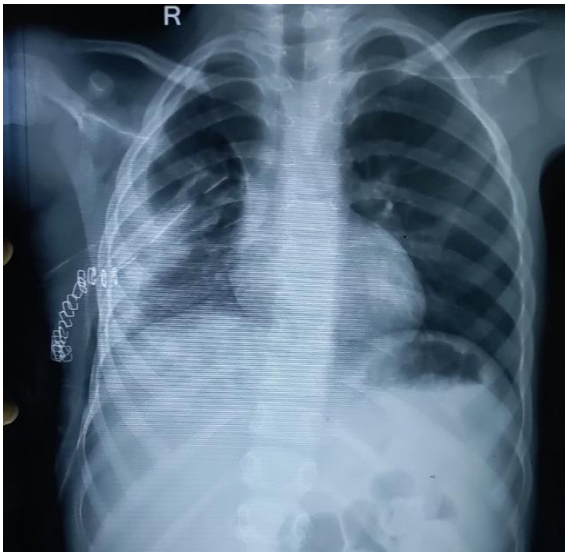
B 

Figure 5: Post operative serial Chest X-rays taken, on (A).POD 1 and (B) On the day of removal of ICD showing lung expansion.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

RESULTS

A total of 22 cases were analysed in the 30 month duration. Four patients underwent VATS and 18 patients underwent primary open thoracotomy when empyema was not relieved by IV antibiotics or ICD insertion .

Out of 22 patients, 13 were male and 9 females with M:F = 1.4:1. Maximum number of patients were in the age group of 4-8 years. Mean age of children was 6.375 years with range of 2 to 14 years.

Table 1. Age distribution of patients

Age In Years	Number Of Cases	Percentage(%)
0-3	3	13.64
3-6	7	31.81
6-9	7	31.81
9-12	3	13.64
12-14	2	9.1
>14	0	0
Total	22	100

Table 2. Sex distribution of patients

Sex	Number Of Cases	Percentage (%)
Male	13	59.1
Female	9	40.9
Total	22	100

The most common cause of empyema thoracis in this study was Gram positive bacterial infection (86.4%). Tuberculosis was diagnosed based on signs of tuberculosis in chest radiography and result of sputum acid-fast bacteria test. All patients positive for tuberculosis were started on anti-tubercular therapy pre operatively, and course was continued post operatively as well.

Table 3. Disease etiology

Etiology	Number Of Cases	Percentage (%)
Gram Positive Bacterial Infection	19	86.4
Tuberculosis	3	13.6
Total	22	100

Most of the patients presented with more than 6 weeks of disease duration before surgery (57.4%) (Fig. 6). Patients with disease durations of 3, 3–6, and >6 weeks were categorized as being in the exudative, fibrin purulent, and fibrinous stages of empyema Thoracis, respectively. In this study, 9 patients had a disease duration of 3–6 weeks, and they were initially managed using an intercostal drainage tube and IV antibiotic therapy. Later, 2 of these patients underwent VATS decortication, , 6 patients underwent primary open thoracotomy and decortication and 1 patient with relatively advanced disease underwent VATS converted to open thoracotomy decortication. 7 patients with a disease duration <3 weeks and with loculated fluid collection

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

underwent primary open decortication. Meanwhile, out of 6 patients with a disease duration >6 weeks, 5 underwent open thoracotomy decortication and 1 patient underwent VATS converted to open thoracotomy and decortication.

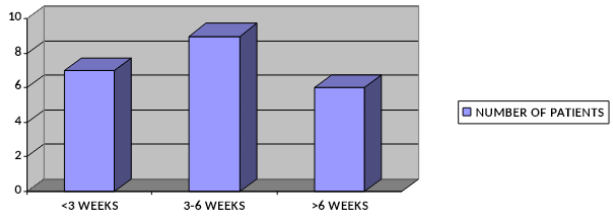


Figure 6. Duration of disease according to the timing of surgical intervention

Of 22 patients, 18 (81.8%) patients underwent open thoracotomy decortication (Table 4). A total of 4 patients underwent VATS, which was converted to open procedure in 2 patients, and the remaining 2 patients had successful VATS decortication. A conversion rate of 50 % for VATS was observed in this study.

Table 4. Procedure of decortication

Procedure For Decortication	Number Of Cases	Percentage (%)
Vats	2	9.1
Open Thoracotomy	18	81.8
Vats Converted To Open Thoracotomy	2	9.1
Total	22	100

In all 22 patients, complete decortication was achieved either by VATS or open thoracotomy procedures. The success rate in attaining complete decorticationswas 50% for VATS and 100% for open thoracotomy. Complete lung expansion post decortication was observed in 19(86.4 %) patients. Complete lung expansion, determined through the observation of the expansion of the decorticated lung reaching the rib cage on ventilation by the anesthetist on table. The remaining 3 (13.6%) patients had poor lung compliance secondary to advanced disease.

ICD with under water seal drainage was placed in all the patients. The drain was removed once the air leak had stopped and/or drainage is <50 mL. In 2 patients who underwent VATS, the drain was removed on the fourth post-operative day, whereas one patient needed the drain for >8 days. The drain was removed on 6^{th} post operative day in 16 open decortications patients, whereas 2 patients needed the drain for >10 days. One patient died.

The common complication we encountered in our study were bronchopleural fistula/air leaks (13.6%) (n=3, 2 of open thoracotomy and 1 of VATS). Air leaks that persisted beyond 6 days were taken into consideration. All the air leaks were managed conservatively with prolonged placement of underwater seal intercostal chest drain and slow suction method (10-15mm Hg) and they gradually healed within one week. All the patients were given preoperative antibiotic prophylaxis with 3rd generation I.V. cephalosporin for 3 days. The pleural fluid culture and

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

sensitivity was done for all the cases and appropriate antibiotic initiated as soon as the microbiology report was done.

One patient that underwent open thoracotomy decortication converted from VATS, had to undergo prolonged ventilation post operatively. The patient remained in pediatric surgery ICU for 17 days at the end of which the patient expired.

Table 5: Postoperative complications

Complications	Number Of Cases(N=4/22)
Bronchopleural Fistula	3
Death	1
Total	4

DISCUSSION

Decortication for the removal of the diseased pleura is still a common surgery performed. The common etiology is development of empyema thoracis secondary to pulmonary diseases like pulmonary tuberculosis, pneumonia, bronchiectasis, lung abscess and chest wall diseases like thoracic wall abscess, penetrating wounds, osteomyelitis of ribs, thoracic vertebrae.
Broad spectrum antibiotic coverage (3rd generation cephalosporin, beta lactase, carbapenems amino glycosides, etc.) is initiated right from admission. Later, antibiotics are changed as per pleural aspirate culture reports. Conventional X-ray chest is usually the first line radiological investigation to detect effusion and pleural space infections; however it must be combined with additional imaging. High resolution CT of thorax helps in diagnosis, identification of pus pockets, pleural fluid thickness, quantity of untrained fluid, extent of parietal and visceral pleura thickening, loss of lung volume and its consolidation.[5,6]

This retrospective study on empyema thoracis in children in our institute shows good pulmonary outcome. The mean age of presentation (6.375 years)found in this study seems similar to studies in the literature.In a study conducted by y Rao et al have found 1 to 5 years (58.3%) to be the commonly affected group.[7]

The most common cause of empyema thoracis in this study was Gram positive bacterial infection (86.4%). In a study conducted by Kummari M et al, 42% patients presented secondary to tubercular pathology whereas 28%patients presented secondary to pyogenic pathology.[8] This notable difference in etiology could be explained by the COVID related immunocompromised status of the pediatric age group. This led to increased incidence secondary bacterial pneumonia which in turn became the leading cause of empyema in post COVID phase.

In this study , we also see that 81.8% children underwent primary open decortication, 9.1% patients under successful VATS decortication and the remaining patients although planned for VATS, had to undergo conversion to open thoracotomy. In a study conducted by Sindgikar V et al,earlier intervention can improve the result and lower morbidity. In advanced stages, open thoracotomy decortication is better at achieving complete decortications than VATS. VATS

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

decortication had less post-operative complication, but it has significant conversion to open procedure with advanced disease. Thus, open thoracotomy decortication remains the gold standard in attaining complete decortications in advanced empyema thoracis.[9] It was noted that there was decreased lung compliance due COVID associated respiratory tract infections which led to increased preference to open thoracotomy over VATS to achieve complete decortication.

The common complication we encountered in our study were bronchopleural fistula/air leaks (13.6%) (n=3, 2 of open thoracotomy and 1 of VATS). It was managed conservatively with slow suction method till the patients healed within a weeks' time. Iyer et al in their review found postoperative air leak as common complication.[10]

There was one death in this study, where the patient was initially taken up for VATS but later had to be converted to open thoracotomy due to technical difficulties in achieving complete decortication. The patient under went prolonged mechanical ventilation and expired at the POD 17.

In a meta analysis conducted by Sokouti M et al,[11] worldwide, the beneficial effects of VATS have been widely reported in treatment of early stages of empyema (i.e., stage II, with limited successful performance at stage III). The results of the current systematic review and meta-analysis suggest no major trends of superior outcomes with VATS versus open surgery decortication in the treatment of empyema thoracis. Hence, VATS and open thoracotomy decortication could be recommended in the treatment of empyema thoracis. However, failed or converted patients from VATS as well as those in advanced stages of empyema can be well managed by open thoracotomy decortication.

CONCLUSION

Empyema thoracis can affect pediatric patients,with peak incidence in 3-9 years age group. Gram positive bacterial infection is the common etiological factor in our region due to the fact that COVID led to immunocompromised status of the children which increased incidence of secondary bacterial pneumonia over TB which used to be the leading cause of empyema in the pre COVID era. Also , COVID related upper respiratory tract infection leading to reduced lung compliance and delayed presentation of the patients led to the surgeons give preference to open decortication over VATS to achieve complete decortication. VATS decortication had fewer post-operative complications, but it has significant conversion to open procedure with advanced disease. Thus, in this study open thoracotomy decortication came out to be a better option for attaining complete decortication in advanced empyema thoracis in pediatric age group.

Conflict of interest: None to declare

Funding: None

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

REFERENCES

1. Coran A. G. &Adzick N. S. (2012). Pediatric surgery (7th ed.). Elsevier Mosby. 870-1
2. Kanai E, Matsutani N. Management of empyema: a comprehensive review. Curr Chall Thorac Surg 2020;2:38.
3. Thakkar PK, Shendurnikar N, Desai H, Doshi V. Empyema thoracis in children: analysis from a tertiary care center. Int J ContempPediatr 2021;8:1478-82.
4. Albal M, Bansod PY, Mashru D. Pediatric empyema thoracis: our surgical experience. Int Surg J 2021;8:1275-9.
5. Mitra AS, Nagdeve NG, Khatri SR, Chandak UA. Video assisted thoracoscopic surgery in the management of acute fibrinopurulent empyema in paediatric patients. Int Surg J. 2020;7(6):1847-51.
6. Shen KR, Bribriesco A, Crabtree T, Denlinger C, Eby J, Eiken P et al. The American Association for Thoracic Surgery consensus guidelines for the management of empyema. J thoracic cardiovascular surg. 2017;153(6):e129
7. Rao MS, Chandra PS. A study of pediatric empyema thoracis presentation in a tertiary care hospital in Visakhapatnam, India. Int J ContemPediatr. 2018;5(2):572.
8. Kummari M, Malempatti AR, Palanki SSG, Bomma K, Chakravarthy G. Outcomes of pleural decortication in a tertiary care hospital of Telangana state. IntSurg J 2020;7:1009-14
9. Sindgikar V, Vallabha T, Patil M, Kullolli G, Reddy S. Empyema Thoracis-the role of open thoracotomy with decortication in the era of video-assisted thoracoscopic surgery. Annals of African Surgery. 2022 Aug 26;19(4):175-9.
10. Iyer A, Yadav S. Postoperative care and complications after thoracic surgery. Principles and practice of cardiothoracic surgery. Intech. 2013 Jun 12:57-84.
11. Sokouti M, Sandeghi R, Pashazadeh S et al. Treating empyema thoracis using video-assisted thoracoscopic surgery and open decortication procedures: a systematic review and meta-analysis by meta-mums tool. *Arch Med Sci* 2019; 15: 912-935.