

## Operative management of pediatric empyema: a single center review

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### Abstract

**Introduction:** Empyema thoracis is an uncommon complication of childhood pneumonias but a common problem faced by a thoracic surgeon. Its management is still controversial, with a range of treatment options available and evolving gradually towards adoption of video-assisted thoracoscopic surgery (VATS) as the most commonly practiced one.

**Aim :** The aim of this study was to review our experience in pediatric empyema thoracis.

**Methods:** It was a retrospective review of the prospectively recorded data, spanning a period of 18 months in the Department of Cardio-Thoracic and Vascular Surgery in Manmohan Cardio-Thoracic Vascular and Transplant Center.

**Results:** A total of 40 consecutive patients, 29 males and 11 females, aged 15 years or less were operated upon for a diagnosis of empyema thoracis made based on clinical, radiological and laboratory evidence. All of them were referred patients, mostly from pediatricians. VATS was undertaken in 36 of them, the remaining four treated by open approach. Deloculation sufficed in majority (26/40; 65%) of the patients which mostly (23/26; 90%) had either acute or subacute presentation. Decortication was required in 35% (14/40) of the patients. However, all of the patients but one had a successful outcome in terms of lung expansion, sterilization of the pleural cavity and absence of recurrence. There was no operative mortality.

**Conclusion:** Surgical management of pediatric thoracic empyema is feasible and safe with favorable outcome. VATS is gradually becoming the more favored modality of operative management.

**Keywords:** Decortication; Deloculation,; Pediatric empyema thoracis; VATS.

### Introduction

Empyema thoracis is an accumulation of infected fluid in the pleural space. It is an uncommon complication of childhood pneumonias but a common problem faced by a thoracic surgeon. It still is associated with high morbidity worldwide.<sup>1</sup> Empyema develops in three stages; exudative, fibrinopurulent and organized stage.<sup>2, 3</sup> The incidence of childhood empyema shows an increasing trend over the last two decades. The rise in the incidence of empyema is partly because of rise in the incidence of multi-drug resistant pathogenic microorganisms.<sup>4,5</sup> Delay in early diagnosis, failure to institute appropriate antimicrobial therapy, multi-

drug resistant organisms, malnutrition, comorbidities, poor health seeking behavior and high treatment cost contribute to increased morbidity in children.<sup>6,7</sup>

There is no consensus regarding the ideal treatment or even the ideal timing of the various treatment options available.<sup>8</sup> An array of treatment options is available. They include intravenous antibiotics with repeated thoracentesis, chest tube drainage, image-directed drainage, fibrinolytic therapy, video-assisted thoracic surgery (VATS), minithoracotomy, and formal thoracotomy with decortication.<sup>9</sup> In recent times the treatment choice is evolving gradually towards adoption of VATS.

## Methods

This was a retrospective review of prospectively recorded data, spanning a period of 18 months (August 17<sup>th</sup> 2016 to 14<sup>th</sup> March 2014) in the Department of Cardio-Thoracic and Vascular Surgery in Manmohan Cardio-Thoracic Vascular and Transplant Center. Ethical clearance was taken from the Institutional Review Board of the Institute of Medicine and approval was taken from the hospital authorities for using patients' data. All patients aged 15 years or less who underwent operative treatment of empyema thoracis were included in the study. Those who were managed with simple intercostal tube drainage only, were excluded. Information on patients' demographic, clinical, operative and postoperative parameters were retrieved from the Medical records, and analysed using Statistical Package for Social Sciences version 17.0 software (SPSS, Inc., Chicago, IL, USA).

The terms *acute*, *subacute* and *chronic* reflected the treating team's judgment based on the clinical picture of the patients, and not necessarily the duration of symptoms alone. Operations (either 'open' thoracotomy or VATS) which entailed breaking the loculi, draining the collection and cleaning the debris from the pleural cavity were termed *deloculation*, whereas those which also included stripping the 'cortex' on the lung were called *decortication*. The chest tubes kept at the end of surgery were removed in the postoperative period once the lung expanded on chest Xray, drainage was clean and less than 50 ml in 24 hours. The need of reinsertion of the chest tube for recollection would make the foregoing operation a failure.

## Results

During the study period, a total of forty patients underwent operative management of empyema thoracis. Thirty five (85%) of them were referred to us from the pediatricians mostly from inside Kathmandu valley, although 92.5% (37/40) of the patients hailed from outside the valley. Twenty nine were males, and eleven females. The patients ranged from 7 months to 15 years in age, with a mean of 8 years ( $\pm 4.19$ ).

All patients had unilateral disease: half had a right sided empyema and the other half- a left one. Five patients were already on antitubercular treatment empirically. All others (35/40) were considered to have complicated a synpneumonic effusion, at least clinically. Twelve (30%) of the patients already had a chest tube drain in situ, obviously without complete resolution of the empyema. The commonest presentation was a variable combination

of fever (80%), cough (70%), difficulty in breathing (70%) and chest pain (45%). One infant had presented as empyema necessitans which had been incised in an attempt to drain an assumed abscess of the chest wall. The duration of symptoms ranged from five days to one year, with a median of 12 days. Sixteen patients (40%) had an acute presentation, 14 (35%) had subacute and 10 (25%) had a chronic one. (Table 1). In 21 patients in whom an ultrasound of the chest had already been done (all of them had a multiloculated collection), a computerized tomogram (CT) of chest was not done. All others had a CT scan done before surgery, which showed a variable sized empyema cavity with loculations.

**Table 1. Clinical presentation**

Group (n)	Duration of symptoms (days)	Mean (SD)
Acute (18)	2-17	7.5 (4.25)
Sub acute (16)	7-45	17.21 (10.71)
Chronic (12)	20-365	82.8

Of the thirty eight patients who were approached with VATS, two had to be converted to thoracotomy: one for too crowded ribs, and the other for massively thickened parietal pleura. Two other patients underwent an elective thoracotomy. Thus a complete VATS was utilized in a total of 36 (90%) patients. Three of the four 'open' cases had a chronic empyema and all four required decortication. Of the 36 in the 'VATS group', deloculation was sufficient in 26 (72%) whereas 10 (28%) required decortication. Of the total 10 patients with chronic empyema, nine had to undergo decortication which was required in only five of the 30 patients with *non-chronic* (acute+subacute) presentation. Most of the patients [29/36 (80.5%)] were operated via standard three ports. The durations of surgery were consistently lower for all (open+VATS) deloculations compared to decortications, and also for VATS deloculations compared to VATS decortications. (Table 2)

**Table 2. Postoperative parameters**

Patient Group (n)	ICU stay (days) Mean (SD)	Hospital stay (days) Mean(SD)	Tube duration (days) Mean (SD)
Total	1.35 (0.5)	4.67 (2.3)	3.12
VATS	1.17 (0.4)	4.47 (2.1)	
Deloculation	1.34 (0.5)	4.11 (1.62)	
Decortication	1.35 (0.65)	5.4 (3)	

All patients stayed in Intensive Care Unit (ICU) for at least one day. The average duration of ICU stay was similar in all groups. (Table 4)

## Discussion

Approximately 0.6% of pneumonias in children are complicated by empyema, defined as the presence of pus in the pleural space, while the incidence of empyema in children ranges from 0.4 to 6 per 1000 admissions.<sup>4</sup> The microbiology of childhood empyema dictates appropriate antibiotic selection. The most common pathogens isolated are Haemophilus influenzae, Staphylococcus aureus, and Streptococcus pneumoniae.<sup>10,11,12</sup> Majority of our patients, however, did not have positive culture results as the majority of them would have been receiving empirical antibiotics before obtaining cultures.

The goal of treatment is to drain pus, obliterate the pleural space thus allowing the lung to expand and function normally, and prevent recurrence. The problem of overt reliance on antibiotics without early drainage is real, and is also manifest in the fact that 70% of the patients did not have a drainage tube in place when they were referred to us, even though 85% of all the referrals came from within Kathmandu valley.

Ultrasonography (USG) is a safe and inexpensive mode of imaging and is used to confirm the presence of pleural effusion, to guide catheter insertion for percutaneous drainage.<sup>13</sup> Park and associates have shown sonography to be superior to CT in evaluating the nature of pleural fluid in their study.<sup>14</sup> However, USG is inferior to CT in detecting loculated effusions in the mediastinal area and in the fissures. CT chest is warranted in complicated cases of empyema as it can detect lung pathology and pulmonary abscess and it is also recommended in preoperative cases of empyema. However, the disadvantages of chest CT are the exposure of a patient to relatively high radiation, the inability to visualize thin pleural septations or fibrin, and the possibility of the need for sedation.<sup>15</sup>

Surgical debridement of the pleural space as definitive management of empyema has been described historically. VATS became the gold-standard tool in the operative management of fibrinopurulent pleural space disease as early as late 20<sup>th</sup> century.<sup>16</sup> Primary VATS has resulted in earlier and more complete resolution of empyema than chest tube drainage alone in both retrospective and prospective studies translating in shorter hospitalization.<sup>17</sup> A retrospective series of 89 children undergoing primary VATS showed 12% risk of a subsequent procedure to

address ongoing disease or a complication.<sup>18</sup> However, such was not the case with the current study, where notably none had recurrence of empyema over a 3 month follow up.

Understandably, good results come with earlier interventions. A retrospective series in children with empyema documented that VATS performed within 48 hours of diagnosis reduced hospital stay by four days on average.<sup>17</sup> Another retrospective study showed a delay between diagnosis and surgery of more than four days significantly correlated with more frequent surgical difficulties, longer operative time, more postoperative fever, longer drainage time, longer hospitalization, and more postoperative complications.<sup>19</sup> Interestingly, despite a median duration of 12 days before surgery, our patients did well, with almost all the parameters comparable to published studies.

## Conclusion

Empyema thoracis is a common problem in children. Early surgical intervention in the form of VATS helps achieve the goals of treatment more effectively. VATS is a safe procedure with acceptable results.

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