Thoracoscopic Decortication as First-Line Therapy for Pediatric Parapneumonic Empyema*
A Case Series

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Study objectives: Previous articles have promoted the early use of thoracotomy and decortication for refractory empyema. This study examines thoracoscopy and decortication at the time of initial chest tube placement in pediatric patients with parapneumonic empyema.

Design: We reviewed the medical records of 16 consecutive patients who were children with parapneumonic empyema.

Results: Thirteen children (group 1) underwent thoracoscopic decortication and tube thoracostomy as their initial operative procedures; 3 children (group 2) had tube thoracostomy alone. In both groups, chest tubes were removed prior to their discharge to home. The mean (± SD) operative time for thoracoscopy was 81 ± 19 min with no complications. On average, chest tubes were removed by postoperative day 4. The mean time to discharge was 8.3 days. Two children eventually required lobectomy. The mean operative time for chest tube placement alone was 21 ± 3 min. Children required chest tube drainage for an average of 12.3 days. The mean time to discharge was 16.6 days. Two patients required a total of five additional operative procedures, including two additional chest tube placements, two open decortications, and one lobectomy.

Conclusions: Thoracoscopic decortication is effective in the early treatment of pediatric parapneumonic empyema. It facilitates visualization, evacuation, and mechanical decortication of the pleural space with no additional morbidity and may lead to reduced time for chest tube drainage, shorter hospitalization, and more rapid clinical recovery.

(CHEST 2000; 118:24–27)

Key words: decortication; empyema; pediatric; thoracoscopy

Parapneumonic empyema is an important source of morbidity and mortality in the pediatric population despite the development of more effective antibiotics and the trend toward earlier surgical drainage in patients in whom medical management has failed.1,2 Due to the evolution of more virulent infecting organisms and the delayed presentation of many patients, conservative management often fails.3 Some studies have focused on the relative merits of surgical intervention.4,5 Surgical options include tube thoracostomy, streptokinase irrigation, thoracotomy with decortication, open chest drainage, and more recently, thoracoscopic decortication.

Closed chest tube drainage is largely ineffective in the setting of loculated effusions, even with the addition of lytic agents.5–8 Thoracotomy can provide definitive therapy but carries significant morbidity. Thoracoscopic decortication has minimal morbidity and accomplishes all of the goals of surgical treatment (ie, evacuation of fluid, disruption of fibrino-purulent septa to allow for reexpansion of the lung, and proper placement of dependent drainage tubes).

The authors have noted an increase in the number of children presenting with empyema after the outpatient management of pneumonia has failed. Since most children require a general anesthetic for chest tube insertion, thoracoscopy can be performed simultaneously, adding no additional morbidity. The objective of this report is to evaluate the use of thoracoscopy as a first-line inpatient treatment for children with parapneumonic empyema.

Materials and Methods

Patients and Data Collection

Sixteen children with parapneumonic empyema were treated by the authors between November 1997 and August 1998.

*From the Department of General Surgery, Carolinas Medical Center, Charlotte, NC. Manuscript received August 24, 1999; revision accepted February 8, 2000.

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Patients presenting with pneumonia (characterized by fever, cough, chest pain, and leukocytosis) were initially evaluated by routine chest radiograph. A presumptive diagnosis of parapneumonic empyema was made in those patients with radiographic evidence of infiltrates combined with a large pleural effusion, unbalanced air-fluid levels, or multiple loculations. Chest CT scanning was used selectively for patients with equivocal chest radiograph findings. Due to the anticipated need for definitive pleural drainage, thoracentesis was not routinely performed. The diagnosis of empyema was confirmed by operative findings (purulence, pleural peel, or lung entrapment) and pleural cultures.

A retrospective review of medical records included demographics, comorbid conditions, duration of prehospital illness, length of hospital stay, duration of antibiotic administration and chest tube drainage, details of surgical interventions, fever curves, WBC counts, culture data, and radiographic studies. All complications were recorded.

Surgical Technique

General anesthesia was used in all cases. For the three patients who underwent tube thoracostomy alone, a single, large-bore chest tube was placed in a standard fashion. Thoracostomy tubes remained in place until drainage had ceased or the chest tubes became nonfunctional. Persistent effusion with failure of clinical improvement was an indication for tube replacement.

Either bronchial intubation or Fogarty catheter balloon occlusion were used for single-lung ventilation in those patients undergoing thoracoscopy. Patients were placed in the lateral decubitus position with the affected side up. A 5-mm thoracoscopic port was initially placed in the mid-axillary line through the lung. A 5-mm thoracoscopic port was initially placed in the mid-axillary line through the lung. A 5-mm thoracoscopic port was initially placed in the mid-axillary line through the lung. A 5-mm thoracoscopic port was initially placed in the mid-axillary line through the lung.

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The mean (± SD) length of time in the operating room was 81 ± 19 min. Patients were afebrile at a mean of 3.7 days following surgery. In the majority (8 of 13 patients), fever resolved within 48 h after surgery, and chest tubes were removed within 5 days in all but 2 patients. Nine of 12 children were discharged to home within 5 days of surgery (Table 1). All chest tubes were removed prior to discharge.

The two patients with the longest postoperative hospital stays (19 and 26 days) did not respond to the initial treatment with thoracoscopic decortication. Following a long course of persistent fever and chest tube drainage, each patient underwent lobectomy for extensive lobar necrosis. Both patients required a

**Results**

Of the 16 children treated for parapneumonic empyema, 9 were boys and 7 girls. All previously had been healthy, although two children had experienced recurrent bouts of otitis media. Ten children presented during the winter months. The average age was 5 years (range, 1 to 16 years). Thirteen children presented with fever. All 16 patients had leukocytosis. Unilateral effusion was present on all admission chest radiographs. Each child received broad-spectrum IV antibiotics.

### Thoracoscopic Decortication

Thirteen children (group 1) underwent thoracoscopy at the time of the initial chest tube insertion (Table 1). These patients had been ill for an average of 10 days (range, 2 to 45 days) and had received antibiotics for a mean of 8 days (range, 0 to 45 days) prior to surgery. The mean WBC count at admission was 19,600/μL. Temperatures on admission ranged from 36.3°C to 39.7°C.

On average, patients underwent thoracoscopy within 3 days of admission (range, 0 to 7 days). Empyema (as evidenced by fibrinous debris, dense loculations, and trapped lung) was confirmed at surgery in 12 patients. Pleural decortication was achieved in each child before chest tube insertion. In one child, thoracoscopy revealed only a clear effusion. In this case, the scope was removed and a chest tube was inserted.

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<th>Table 1—Comparison by Treatment Modality*</th>
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*Values given as mean ± SD (range), unless otherwise indicated.
single perioperative blood transfusion at the time of the thoracotomy. One patient was readmitted within 30 days with a urinary tract infection. There were no deaths.

**Tube Thoracostomy Alone**

Three children (group 2) were treated initially with chest tube placement only (Table 1). Each of these children was treated at our center prior to our initial experience with thoracoscopy. On average, these patients had been ill for approximately 7 days (range, 5 to 10 days) prior to admission. One patient had been treated with oral antibiotics for 4 days before admission. The mean WBC count at admission was 15,000/μL. The temperature on admission ranged from 38°C to 39.3°C.

In each of the three patients, the initial chest tube was inserted within 48 h of admission. All chest tubes were placed while the patients were under general anesthesia. Two of three patients did not improve after undergoing tube thoracostomy and receiving antibiotics. One patient required the replacement of the chest tube at days 3 and 12 following the initial insertion. Open decortication 1 week later resulted in transient clinical improvement. The patient ultimately required a lobectomy for pulmonary abscess and necrosis 33 days after the initial chest tube placement. The second child remained ill after 1 week of chest tube drainage. He underwent a thoracotomy and open decortication and was discharged to home 5 days later.

**Microbiology**

Gram’s staining of pleural fluid identified polymorphonuclear leukocytes in 11 of 16 children. Gram’s staining was positive for bacteria in only two patients. Final cultures were positive in 4 of 16 patients. Three blood cultures grew out *Streptococcus pneumoniae*, with one corresponding pleural fluid culture positive for *S pneumoniae*. One tissue culture (pleural peel) was positive for coagulase-negative *Staphylococcus*.

**Outcome**

At the time of hospital discharge, the findings on chest radiographs in all 16 patients lagged behind the clinical resolution of disease. Findings on CT scans and/or chest radiographs prior to discharge included atelectasis (n = 8), pleural thickening (n = 7), pulmonary infiltrate (n = 5), residual pleural effusion (n = 4), pneumatocele (n = 3), loculated fluid (n = 2), and lobar cavitation (n = 1). All children returned to normal activity, and chest radiograph findings have normalized over a 3- to 12-month follow-up period.

**Discussion**

Since the clinical entity of empyema was first described, its optimal treatment has been continually debated.9 With the development of more potent antibiotics and the advent of newer techniques for pleural drainage, therapy has become more effective and less morbidity has occurred.

Although tube thoracostomy is effective in the treatment of many early empyemas, 18 to 60% of children do not respond to closed drainage.3,10 Most children do not present during the first 24 to 72 h of empyema development, when the pleural fluid is thin and easily drained. The majority (15 of 16 patients in our study) have progressed to the fibrinopurulent stage of empyema, when thick fluid and loculations render even large-bore chest tubes ineffective.

In our series, pediatric parapneumonic empyema was effectively treated with thoracoscopic decortication at the time of the child’s initial chest tube insertion. In contrast, the response to tube thoracostomy alone was poor. Although the two groups in our series were clinically and demographically similar, a direct comparison of results is not possible due to the small number of patients and the absence of randomization. Therefore, conclusions regarding the superiority of thoracoscopy over tube thoracostomy should be interpreted in the context of previous work in this area. Historically, tube thoracostomy alone has been associated with a relatively high rate of nonresponsiveness. In a previously published series of 21 pediatric patients treated with antibiotics and tube thoracostomy, chest tubes remained in place for 14 days and the average hospital stay after chest tube placement was 16 days. Two thirds of the patients required open decortication or “conversion to an open empyema tube” for long-term management.3

In a similar series, 23 children with empyema were treated initially with tube thoracostomy. Of these, 11 patients required the placement of a second chest tube, 8 subsequently needed open decortication, and 3 underwent lobectomy for pulmonary abscess.1

Two studies have demonstrated a good outcome after surgical drainage.2,10 Many authors, therefore, advocate early thoracotomy and decortication in children and adults who have not responded to standard therapy.11–14 While open drainage is effective, thoracotomy adds considerable morbidity.

Minimally invasive techniques have been employed with encouraging results in some cases of refractory empyema. In previously published pediatric series, however, thoracoscopy was used only after initial therapy with antibiotics and chest tube drainage had failed. Rapid clinical improvement was
observed in most patients, and postoperative hospital stays ranged from 6 to 13 days.\textsuperscript{5,15–17} Despite these encouraging results, no previous studies have evaluated the role of thoracoscopy as a primary treatment in children with parapneumonic empyema. Early in our series, we recognized that loculations were present in almost all children with parapneumonic effusions. Since tube thoracostomy alone is ineffective against loculated fluid, we began inserting the thoracoscope at the time of the initial chest tube placement. Fibrinopurulent empyema was present in 12 of 13 children. Each responded rapidly to thoracoscopic decortication, with the exception of two patients who both had lobar necrosis. This experience compares favorably to one series in which 6 of 21 patients required thoracotomy after thoracoscopic decortication. Notably, all these patients had not responded to an initial trial using chest tube drainage and antibiotics.\textsuperscript{5}

One criticism of the use of minimal-access techniques is the higher cost compared with open operation. Thoracoscopic decortication requires very little equipment; a 5- or 10-mm laparoscope and a single, disposable thoracoport. In our series, the operative time was 60 min longer than for chest tube placement alone; however, the average hospital stay was considerably shorter in the thoracoscopy group when compared with tube thoracostomy alone (8.3 vs 16.6 days, respectively).

**CONCLUSION**

Although our study is limited by its small size and lack of a randomized control group, we believe that parapneumonic empyema in children can be expeditiously diagnosed and treated by thoracoscopy and decortication when the child initially receives the anesthetic for chest tube placement. Thoracoscopy allows for the effective drainage of the pleural space with no additional morbidity and may result in a shorter hospital stay than tube thoracostomy alone. A larger, prospective study is warranted to compare the two techniques and to identify patients with complicated features (pulmonary abscess or necrosis) who may benefit from earlier treatment with tube thoracostomy.

**ACKNOWLEDGMENT:** The authors thank Ms. Cissy Moore-Swartz for her assistance with the manuscript.

**REFERENCES**