Management of Thoracic Empyema: Review of 112 Cases

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Abstract- To review our experience in treatment of patients with thoracic empyema at a teaching hospital chart of patients were retrospectively reviewed over a 72-month period. A total of 112 patients (94 men, 18 women, mean age: 39, range: 6-89 years) underwent therapeutic procedures for thoracic empyema between 2001-2006. The causes of empyema included parapneumonic empyema (60.7%), thoracic trauma (20.5%), surgical procedures (7.1%) and seeding from an extra-pulmonary source (11.7%). Multiloculated empyemas were documented in 45 patients (40%). Insertion of chest tube was the first procedure in 103 patients (92%). Nineteen patients (17%) were treated by thoracotomy, ten patients (8.9%) had fibrinolytic therapy, eight patients (7.2%) underwent video assisted thoracic surgery (VATS) and sixteen patients (14.3%) had subsequent radiologic-guided drainage. Thoracotomy-Decortication was successful in 90% of patients undergoing surgery and the least successful intervention was tube thoracostomy alone. Twelve of 112 patients (10.7%) died in the hospital including one patient in the thoracotomy group. Long-term follow-up was available in 67 patients including all of patients requiring surgery and fibrinolytic therapy. Thirty four patients (50%) obtained complete functional recovery. Simple drainage as the first procedure for the treatment of thoracic empyema has a high failure rate. Selection of a therapeutic option should be based on age, underlying disease, stage of the empyema, state of the loculation, local expertise and availability. Surgical procedures such as VATS or thoracotomy are recommended as the first procedure in elderly patients and advanced empyema.

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Introduction

Pleural space infection is common and causes significant morbidity and mortality up to 10%. The proper management of empyema remains controversial, and patients are often seen by a physician after their purulent process has already reached the fibrinopurulent or chronic stage. These patients are often subjected to multiple procedures and long hospitalization before the empyema is successfully treated (1). Most cases are treated initially using antibiotics with or without repeated thoracentesis or chest tube insertion. Surgical approaches, such as video-assisted thoracic surgery (VATS) or open thoracotomy and decortications, are usually reserved for patients with deteriorated clinical condition following failed conservative treatment, which in turn increase the mortality rate. The aim of our retrospective study is to evaluate our experience with thoracic empyema over a 72-month period with special attention to procedures used, success rate of each procedure and outcome.

Materials and Methods

A retrospective chart analysis on patients in whom thoracic empyema was diagnosed from March 2001 to March 2006 at Hazrat Rasool Hospital, Tehran, Iran, was performed. The definition of empyema was selected as any pleural fluid that was grossly purulent, and/or had a positive Gram stain or culture and empyemas were classified by etiology and culture results.

Charts were reviewed for patients age, symptoms, underlying disease, etiology of empyema, culture results, diagnostic modalities, duration of hospitalization, therapeutic intervention, date of procedures, complications, mortality and long-term outcome.

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Measurements

Preoperative length of stay was defined as the interval between the date of hospital admission and surgical intervention. The duration of post-operative length of stay was defined as the interval between the date of surgical intervention and date of hospital discharge. Perioperative mortality was defined as the percentage of patients who died of causes related to the empyema or operation within 30 days of surgery. Successful procedures were defined by empyema resolution such that no further intervention was needed. The clinical long-term results were assessed by the respiratory symptoms using the modified Medical research Council (MRC) dyspnea scale (Table 1).

Results were expressed as mean±SD. Continuous variables were compared with student t test, while non-continuous factors were analyzed with the χ^2 or Fisher exact test. A *P*-value of <0.05 was considered to be statistically significant.

Results

A total of one-hundred and twelve patients, (94 men, 18 women, mean age 39 years, age range 6-89 years) with thoracic empyema were included in this study. The most common cause of empyema (68 cases, 60.7%) was parapneumonic. In the rest of cases, causes of empyema were: thoracic trauma (23 cases, 20.5%), surgical procedures (8 cases, 7.1% including laparotomy for trauma-peritonitis-bowel resection and thoracotomy for persistent air leak-clotted hemothorax), seeding from an extra-pulmonary source such as bacteremia (4 cases, 3.6%), spontaneous pneumothorax (2 cases, 1.8%), esophageal perforation (2 cases, 1.8%) and undetermined (5 cases, 4.5%).

The most common symptoms were fever (75%), cough (65%), dyspnea (40%) and chest pain (45%). The most common medical and social co-morbidities were diabetes, chronic renal failure, smoking and drug abuse (addiction). Of 90 patients for whom information was available 51% had purulent fluid obtained from the first pleural fluid sample. In the remaining patients, the diagnosis of empyema was made by positive Gram stain and corresponding clinical features. No pleural fluid culture was sent for 65 (58%) patients. The results of culture were reported negative in 27 patients of the remaining 47 patients for whom pleural fluid culture was sent. Positive results of culture revealed, in order of decreasing frequency, the following bacterial species: Gram-negative organisms (*Hemophilus influenza*, *Serratia marcescens*), gram-positive organisms (*Streptococcus pneumonia*), Anaerobes (*Bacteroid melanogenicus, Pepto-streptococcus*).

Imaging modalities including chest x-ray and computed tomography (CT) scan were requested for all patients, and although lateral and decubitus radiographies were available for only a minority of patients, repeat CT scan was done for 40% of patients.

Multiloculated empyemas were documented in 45 patients (40%). All patients except nine (103 cases) underwent a drainage procedure after the empyema was diagnosed which includes the insertion of a thoracostomy tube (92%). The first step in management in other patients (9 cases) included surgical procedures such as thoracotomy (1 case) -VATS (3 cases) and image-guided drainage (5 cases). As a whole, nineteen patients (17%) were treated by thoracotomy, ten patients (8.9%) had fibrinolytic therapy by streptokinase, eight patients (7.2%) underwent video-assisted thoracoscopic surgery (VATS) and sixteen patients (14.3%) had subsequent radiologic guided drain placed. Utilization and success rate for each procedure is listed in table 2. These procedures especially surgical methods were generally performed in multiloculated cases. All patients received antibiotics and the most commonly administered antibiotics were metronidazole or clindamycin and ceftriaxone. Other antibacterial agents included imipenem, vancomycin, ciprofloxacin and piperacillin-tazobactam.

Table 1. The modified Medical Research Council (MRC) dyspnea scale.

Score	Symptoms
0	Not troubled with breathlessness except with strenuous exercise
1	Troubled by shortness of breath when hurrying on the level or walking up a slight hill
2	Walks slower than people of the same age on the level because of breathlessness or has to stop for breath when walking at own pace on the level
3	Stop for breath after walking about 100 yards or after a few minutes on the level
4	Too breathless to leave the house or breathless when dressing or undressing

Table 2. Success of treatment of thoracic empyema.

Procedure	Total	Used as first procedure	Successful procedures No. (%)
Tube thoracostomy	103	103	50 (48.5%)
Image-directed catheter	16	5	13 (80%)
Intrapleural fibrinolytic	10	0	7 (70%)
Thoracotomy-decortication	19	1	18 (95%)
VATS	8	3	6 (75%)

Table 3. Post procedural respiratory results: subjective dyspnea degree.

MRC dyspnea scale	Decortication No. (%)	VATS No. (%)	Fibrinolytic therapy No. (%)
0	12 (65%)	5 (62%)	6 (60%)
1	5 (25%)	2 (25%)	3 (30%)
2	2 (10%)	1 (12%)	1 (10%)
3	0	0	0
4	0	0	0

Patients had their chest tubes removed from 4 to 60 days after their procedure (median 15 days). Preoperative length of stay ranged from 5 to 20 days. Post-operative hospital stay ranged from 7 to 25 days (median 10 days). There was no intra-operative death and 12 of 112 patients (10.7%) died in the hospital which includes one patient who had undergone thoracotomy. Surgical complications included significant air leak in two patients, persistent hemorrhage (>400 ml/day over 3 days) in one patient in the VATS group and wound infection requiring local debridement and drainage in one patient.

Long-term follow-up (2-3 years) was available in 67 patients (60%) including all of patients requiring surgery and fibrinolytic therapy. Thirty four patients (30% of the total) achieved complete functional respiratory recovery without dyspnea even for intense exercise (MRC degree 0). For the nineteen patients who underwent thoracotomy, subjective dyspnea degrees include the following: MRC degree 0=12 patients (65%) MRC degree 1=5 patients (25%) MRC degree 2=2 patients (10%). The corresponding figures for the VATS and fibrinolytic therapy groups are depicted in table 3.

Discussion

Pleural empyema still represents a significant cause of morbidity, prolonged hospitalization and mortality up to 10%. Important and common causes of empyema include pulmonary infection, surgical procedures, trauma, spontaneous pneumothorax, sub-diaphragmatic infection and esophageal perforation.

Approximately 50% of all bacterial pneumonias develop a pleural effusion, and in one-third of these patients the pleural effusion becomes organized (2). The propensity for developing empyema varies considerably with the type of bacteria producing the primary pneumonia, the setting in which the infection is acquired and the alteration in these produced by antibiotic therapy. The second most frequent cause of empyema is post-surgical empyema which accounts for 20% of all cases (3).

The clinical picture of thoracic empyema may also be seen with pulmonary embolism, acute pancreatitis, Dressler's syndrome and tuberculosis. Complications of the empyema process may take place early or late and include broncho-pleural fistula, empyema necessitates, osteomyelitis of the ribs or spine, invasion of the mediastinum with pulmonary-esophageal fistula or pericarditis and brain abscess (4). Once the diagnosis of pleural empyema has been made by thoracentesis and appropriate Gram's stain and/or culture, computed tomographic (CT) scan is now used universally to identify underlying parenchymal disease, to distinguish empyema from lung abscess and to verify the presence of loculations, the latter being an important factor in treatment planning.

Effective management of empyema requires control of infection by appropriate antibiotic therapy, evacuation of pus and obliteration of the empyema cavity (4). The most important aspect of management is the prompt initiation of effective drainage. Closed chest tube drainage is the usual first step which may take a number of forms including image-guided catheter insertion.

Patients frequently come to medical attention when the pleural fluid is not free flowing and closed drainage is unlikely to be successful.

The options available to manage inadequate drainage include additional chest tubes, intrapleural fibrinolytics, VATS and thoracotomy-decortication (5). The choice of an additional drainage modality depends upon the presence of ongoing pleural sepsis, maturity of empyema, degree of restriction of lung function, familiarity with the treatment modalities and debility of the patient. Simple drainage via tube thoracostomy as the first procedure has a low success rate and is a predictor of failure of the initial therapy (6). This was true in our population where fifty-three patients (47%) underwent various other procedures. One option is image-guided catheter placement which is safe and highly effective in select patients (7). Our success rate of 80% with this modality is similar to early reports of drainage by this procedure (8) and represents the selection of patients with non-loculated early empyema. However, the added cost of multiple CT scans and the need for multiple catheters in some patients is a potential drawback.

Intra-pleural fibrinolytic therapy is another option when there is occlusion of the chest tube with viscous material or there are multiple loculations that fail to drain. Proper staging of the empyema is important when using fibrinolytics since it is less likely to resolve thick-walled uni-loculated empyema, where the problem is more often incomplete re-expansion of the lung.[1] Based on the available evidence, intra-pleural fibrinolytics should not be used for mature empyema but may be considered for early fibrinopurulent stage (5). A Cochrane review of seven randomized controlled trials recruiting 761 patients suggested a potential overall treatment benefit with fibrinolytics but noted that the results should be treated with caution as the data were incomplete and the benefit was not significant (9). Although, the number of patients in our study treated by fibrinolytic therapy was small (ten patients) but the success rate of 70% justifies the use of this modality in early empyemas. On the other hand, Maskell *et al.,* (13) reported that in a double-blind trial, 454 patients with pleural infection were randomly assigned to receive either intrapleural streptokinase (250,000 IU twice daily for three days) or placebo. They concluded that, the intrapleural administration of streptokinase does not improve mortality, rate of surgery, or the length of hospital stay among patients with pleural infection

Surgical approaches, such as open thoracotomy-decortication or VATS, are generally reserved for patients with failed conservative treatment. The lack of large, multicenter, randomized, double-blinded studies evaluating the role of thoracotomy in the management of empyemas results in difficulty defining the exact role of this invasive procedure. Most studies of this technique predate the widespread use of VATS. However, regardless of the type of approach the surgical treatment can solve the pleural infection in almost all patients (1,10) and decortications in our review also had an excellent success rate of 95%. Stage of the empyema and patient's age are two important determining factors in this regard and surgical treatment as an initial therapy for advanced empyema and/or elderly patients is associated with better outcomes (6,11). Open surgery can be performed at any stage of the empyema, but a key point for the effectiveness of VATS is the early surgical referral and its use in the fibrinopurulent phase (12).

The main limitation of our study is related to its retrospective design, prohibiting the equal randomization of patients undergoing different procedures. There is clearly an increased need in our patients for a second therapeutic intervention despite the use of an intercostals tube for a high percentage of patients. Many patients in this study waited an unacceptable length of time between procedures which represents the lack of selection of the most appropriate first procedure and underestimating the multiloculated nature of the empyemas. Decortication should be considered early in any patient with multiloculated empyema who is a good surgical candidate because it has a high success rate.

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