ABSTRACT

Background: Post-pneumonectomy empyema is a major therapeutic challenge in thoracic surgery. The presence or absence of a concomitant bronchopleural fistula directs treatment of this condition. When there is no bronchopleural fistula the condition is classically treated with thoracostomy drainage, irrigation and antibiotic instillation with closure. This approach is, however, associated with a significant rate of primary failure. Alternative modified techniques involve opening the thoracic cavity widely with serial debridement followed by interval closure. Multiple surgical procedures often require a protracted hospital stay.

Methods: We describe a technique in three patients utilizing video-assisted thoracoscopic surgery for debridement and closure of the pneumonectomy cavity.

Conclusion: Advantages of this technique include debridement under direct visualization, low morbidity, and potential for a shorter hospital stay.

Key Words: Post-pneumonectomy empyema, Video-assisted thoracoscopic surgery (VATS)

INTRODUCTION

Post-pneumonectomy empyema occurs in a small percentage of patients and continues to be a major therapeutic challenge. Etiology of this problem includes bronchopleural fistulae, wound dehiscence, or a persistent nidus of colonized pleura. Clinical manifestations with spiking fever, purulent sputum production, and generalized malaise are the prelude to appearance of a new air-fluid level or loss of fluid level and/or loculation in a previously homogeneous hemithorax on chest roentgenogram. Patients rarely present with mild constitutional symptoms and wound dehiscence or empyema necessitans.

The goals of treatment are control of infection, closure of the bronchopleural fistula if present and obliteration of the cavity. Treatment algorithms segregate post-pneumonectomy empyema into those with versus those without concomitant bronchopleural fistula. Early infections with bronchopleural fistula are managed by debridement of the bronchial stump with closure and reinforcement of the repair with vascularized tissue. Once the pneumonectomy space is clean it is filled with antibiotic solution and closed. Failure of this technique necessitates filling the cavity with muscle tissue transposition with or without thoracoplasty.

Patients without bronchopleural fistula have been treated successfully with open drainage, irrigation, and instillation of antibiotic solution with closure. Stafford and Clagett initially described this technique in 16 patients. Alternatively, closed drainage with continuous irrigation and interval closure upon achieving sterile fluid cultures as suggested by Rosenfeldt and colleagues has also been successfully employed by others. A primary failure rate of up to 40% has been reported for these techniques, perhaps secondary to inadequate debridement of potentially infected fibrinous debris and non-viable tissue.

Video-assisted thoracoscopic surgical (VATS) drainage and debridement of the pleural cavity allows complete removal of all devitalized tissue. This approach can significantly increase the probability of successful management of this problem with irrigation and antibiotic instillation. We report three cases of post-pneumonectomy empyema managed using VATS techniques; two without evidence of bronchopleural fistula and one with a healed fistula.
CASE 1

A 66-year-old man presented with a right hilar mass confirmed on bronchoscopy to be moderately differentiated adenocarcinoma. Following a negative mediastinoscopy, exploratory thoracotomy revealed a right lower lobe tumor with direct inferior mediastinal invasion and deemed unresectable at that time. The procedure was aborted and the patient entered a course of chemotherapy and radiation. Computed tomograms performed midway in the treatment protocol showed significant tumor regression. A repeat right posterolateral thoracotomy and pneumonectomy was then performed. The bronchial stump was reinforced with an azygous vein and intercostal muscle pedicled flap.

The postoperative course was unremarkable until five months later when he presented to the clinic complaining of a mass in the anterior aspect of his thoracotomy wound. The chest radiograph that had previously been homogenous now showed a decreased fluid level with multiple localizations. A thoracostomy tube was placed and 800 cc of turbid fluid drained over the next three days. Bronchoscopy demonstrated an intact bronchial stump and no evidence of tumor recurrence. After placement of a thoracic epidural infusion catheter and a single lumen endotracheal tube, VATS exploration was performed through the slightly enlarged thoracostomy site. Once in the pneumonectomy space, aggressive debridement of devitalized tissue was performed under direct vision. Two size 32 French thoracostomy tubes were placed into the thoracic cavity and irrigated thrice daily with a bacitracin solution. At the conclusion of the ten-day course, satisfied with the debridement of the pleural space, the hemithorax was filled with the same antibiotic cocktail employed in Case 1 (except fluconazole was substituted for nystatin due to a formulary change) and the subcutaneous tissue and skin closed in one watertight layer.

At the six-month clinic visit the right thoracotomy wound and thoracostomy sites were clean and well healed. Chest roentgenogram demonstrated a small apical air collection with no evidence of subcutaneous emphysema. The right hemidiaphragm was elevated with shift of the mediastinum to the operative side.

CASE 2

A 68-year-old man with a diagnosis of right upper lobe lung cancer underwent a right pneumonectomy at an outside institution. His immediate postoperative period was uneventful. Six months after his pneumonectomy he presented to our institution with purulent discharge from his wound and mild constitutional symptoms. The wound appeared superficial, but was suspicious for an underlying empyema. Skin dehiscence progressed and wound exploration confirmed communication with the thoracic cavity. No bronchopleural fistula or tumor recurrence was identified on bronchoscopy.

Under thoracic epidural analgesia and single lumen endotracheal anesthesia a two-centimeter length of exposed rib

Four months later the patient was referred for further evaluation. Bacterial cultures of the drainage fluid from the hemithorax were sterile. Bronchoscopy demonstrated a healed bronchial stump and no evidence of tumor. Using the access provided by the Eloesser flap, a thorough VATS debridement and irrigation of the hemithorax was performed. This procedure was repeated on four occasions in the ensuing ten days. In the intervening period the cavity was continuously irrigated with antibiotic solution. At the conclusion of the ten-day course, satisfied with the debridement of the pleural space, the hemithorax was filled with the same antibiotic cocktail employed in Case 1 (except fluconazole was substituted for nystatin due to a formulary change) and the subcutaneous tissue and skin closed in one watertight layer.

The patient did well for four months but developed a recurrence of the bronchial fistula. He underwent repeat thoracotomy, closure of the fistula, and reinforcement of the stump with a transposed serratus anterior muscle pedicle flap. Four days later the remaining cavity was obliterated with a pedicle transfer of omentum and partial thoracoplasty. Patient was well for six months but died subsequently of cerebral metastasis.

CASE 3

A 68-year-old man with a diagnosis of right upper lobe lung cancer underwent a right pneumonectomy at an outside institution. His immediate postoperative period was uneventful. Six months after his pneumonectomy he presented to our institution with purulent discharge from his wound and mild constitutional symptoms. The wound appeared superficial, but was suspicious for an underlying empyema. Skin dehiscence progressed and wound exploration confirmed communication with the thoracic cavity. No bronchopleural fistula or tumor recurrence was identified on bronchoscopy.

Under thoracic epidural analgesia and single lumen endotracheal anesthesia a two-centimeter length of exposed rib
Advantages of the classic procedure include better visualization and debridement of the thoracic cavity; this approach does however require two major operative procedures with a protracted time spent at home with thoracostomy drainage tubes. The modified protocol while requiring a less invasive surgery does not offer the ability for aggressive pleural debridement and requires a prolonged hospital stay with continuous irrigation catheters in place.

Wong and Goldstraw recently reviewed 23 post-pneumonectomy empyema cases without bronchopleural fistula included the classic two-stage approach described by Clagett with open thoracotomy, debridement and irrigation, and interval closure. In an effort to shorten the hospital stay and minimize discomfort and morbidity, subsequent modifications have employed continuous irrigation to sterilize followed by wound closure. Conklin reported success in two patients with thoracotomy, debridement, irrigation, and closure of the thorax with 0.25% neomycin solution at one operative procedure. Many irrigation solutions have been used in the empyema cavity and debated in the literature.

DISCUSSION

Empyema occurs in less than 10% of pneumonectomy patients. Treatment options in cases without bronchopleural fistula include the classic two-stage approach described by Clagett with open thoracotomy, debridement and irrigation, and interval closure. In an effort to shorten the hospital stay and minimize discomfort and morbidity, subsequent modifications have employed continuous irrigation to sterilize followed by wound closure. Conklin reported success in two patients with thoracotomy, debridement, irrigation, and closure of the thorax with 0.25% neomycin solution at one operative procedure. Many irrigation solutions have been used in the empyema cavity and debated in the literature.

Advantages of the classic procedure include better visualization and debridement of the thoracic cavity; this approach does however require two major operative procedures with a protracted time spent at home with thoracostomy drainage tubes. The modified protocol while requiring a less invasive surgery does not offer the ability for aggressive pleural debridement and requires a prolonged hospital stay with continuous irrigation catheters in place.

Empyema patients reviewed by Alfageme in 1993 showed positive pleural fluid cultures in 76 of 82 patients; 53% of these were caused solely by anaerobic organisms. Multiple bacteria were present in 56% of cases with an average of 2.63 organisms per case. An earlier review by Bartlett found 76% of patients had infection with solely an anaerobic organism or a mixed infection with aerobic species. Given the propensity for colonization by anaerobes, double coverage with the bactericidal cell wall inhibitors gentamicin and kanamycin is recommended. Bacitracin provides broad spectrum Gram positive and negative coverage against commonly isolated organisms such as Staphylococcus aureus and Escherichia coli.

Our recommended protocol of video-assisted thoracoscopic irrigation assessment provides enhanced exposure of the thorax, perhaps even better than open thoracotomy, enabling an aggressive and thorough debridement of the pleural surface. Trocar ports are placed through the drainage tract extending from the wound surface. After debridement, thoracostomy drainage tubes are placed under direct vision and irrigation of the cavity is maintained. If a large cavity is present, it is packed with antibiotic soaked gauze rolls. This regimen is followed until the cavity is clean and sterile. The patient is returned to the operating room, and under sterile conditions with epidural analgesia the thorax is filled with a solution of bacitracin (200,000 units/liter), gentamicin (100 mg/liter), kanamycin (150 mg/liter) and fluconazole (200 mg/liter). The thoracostomy incisions are closed simultaneously under regional anesthesia.

The VATS approach to treatment of post-pneumonectomy empyema reduces exposure of sterile tissue planes to infection by limiting the surgical incision necessary for access to the chest. Potential bone contamination secondary to rib resection is avoided as is a second major operative procedure and anesthetic. We believe thoracoscopy provides better exposure than thoracotomy for pleural debridement. Complete removal of devitalized tissue and debris will decrease the amount of time required for postoperative irrigation and should minimize the number of recurrences after initial treatment. Bronchopleural fistulae require closure with tissue reinforcement before this technique can be employed.

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