Original Article

Management of chronic empyema with unexpandable lung in poor surgical risk patients using an empyema tube

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ABSTRACT

Objectives: High preoperative risk precludes decortication and other surgical interventions in some patients with chronic empyema. We manage such patients by converting the chest tube into an "empyema tube," cutting the tube near the skin and securing the end with a sterile clip to allow for open pleural drainage. The patient is followed serially, and the tube gradually withdrawn based on radiological resolution and amount of drainage. **Methods:** Between 2010 and 2014, patients with chronic empyema and unexpandable lung, deemed high-risk surgical candidates, had staged chest tube removal, and were included for the study. The volume of fluid drained, culture results, duration of drainage, functional status, and comorbidities were recorded. **Measurements and Results:** Eight patients qualified. All had resolution of infection. The tube was removed after an average of 73.6 ± 49.73 (95% confidence interval [CI]) days. The mean duration of antibiotic treatment was 5.37 ± 1.04 (95% CI) weeks. None required surgery or experienced complications from an empyema tube. **Conclusion:** A strategy of empyema tube drainage with staged removal is an option in appropriately selected patients with chronic empyema, unexpandable lung, and poor surgical candidacy.

KEY WORDS: Chronic empyema, empyema tube, unexpandable lung

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INTRODUCTION

Empyema thoracis is defined as the presence of pus in the pleural space or a purulent pleural effusion.[1] An empyema lasting 4 weeks and beyond is classified as chronic empyema.[2] Empyema is divided into three stages (phases): Stage I (acute exudative phase), Stage II (subacute fibrinopurulent phase), and Stage III (chronic organizing phase).[3,4] In Stage I, the visceral pleura remains elastic, and dimensions of the thoracic cavity are maintained. Stage II is characterized by a turbid, infected fluid with fibrin deposits constructing bridges that septate the effusions, creating multiple loculations. In Stage III, this construct is replaced by formal granulation tissue. The acute and sub-acute forms of empyema are easily managed with chest tube insertion and antibiotics with intrapleural fibrinolytics, and may occasionally require surgery.[5,6]

Chronic empyema is characterized by thickened visceral and parietal peels which hamper the ability of the affected lung to re-expand and requires definitive surgical intervention, i.e., decortication with or without lung resection and/or pleural obliteration procedures like thoracoplasty and/or myoplasty.[7] These procedures, however, require a fit patient with a healthy ipsilateral lung for a successful outcome. Frequently, these patients are so debilitated that they are eligible for neither decortication nor pleural obliteration surgeries, but still require drainage for uncontrolled empyema. Such patients may have a thick pleural rind

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and entrapment of the ipsilateral lung by the thick empyema membrane, which stabilizes the mediastinum. In addition, there are often areas of pleural symphysis along the area of lung that is not entrapped. These processes allow the pleural space to be opened to the atmosphere without fear of lung collapse.[8] Hence, open pleural drainage strategies are advocated for management of these patients. Commonly employed open drainage strategies include "open pleural window" thoracostomy (OPW), i.e. Eloesser flap, or some modification of this surgery.[3,9-11] Some patients are too debilitated to undergo such an invasive procedure. Another major drawback of OPW is resulting cosmetic disfigurement. A "prosthesis for open pleurostomy" (POP) device has been described as a management option.[12] There are a few reports of successful treatment of an infected pleural space by drainage via tunneled indwelling pleural catheter (PleurX),[13,14] but placement is usually contraindicated in active intrapleural infection. Although better tolerated than definitive surgical intervention, open pleural drainage strategies are not devoid of surgical morbidity and poor cosmetic results. Thus, there is a need to devise a pleural drainage procedure that is simple, effective, and minimally invasive in nature. Such an intervention would be suitable for sick patients ineligible for most surgical drainage options.

In the current series, we describe our experience managing such patients by converting tube thoracostomy (chest tube) into an open pleural drain, which we have termed an "empyema tube," as an alternative to the strategies previously described.

METHODS

This observational study includes patients treated at the University of Florida (UF) hospitals between January 2010, and August 2014. We collected data on all patients who had received intrapleural fibrinolytics for the management of empyema but had nonresolution or inadequate treatment response. Patients considered unfit for surgical intervention after consultation with thoracic surgeons and with underlying unexpandable lung based on imaging findings were discharged with the "empyema tube" and were included for this study. The study was approved by the Institutional Review Board of UF, and a standardized protocol was followed throughout every stage of the study. Demographic information, age, sex, comorbidity, and procedure-related complications were recorded. Other data recorded included the length of hospital stay, drainage volume from the chest tube, duration of chest tube drainage, number and cumulative duration of antibiotics used, need for thoracic surgical intervention, blood and pleural fluid culture results, need for additional chest tubes, and functional status of the patient.

Protocol

All patients underwent an initial 3-day course of once-daily sequential intrapleural tissue plasminogen activator (10 mg in 50 mL of sodium chloride), and deoxyribonuclease (DNAse, 5 mg in 30 mL of sodium chloride) administration as per protocol followed at our center. Those with chronic empyema with unexpandable lung, deemed to be poor surgical candidates, were given the option to convert their chest tubes to empyema tubes. Unexpandable lung was confirmed based on visceral pleural thickening on computed tomographic scan, and lack of expansion of the ipsilateral lung with continued negative suction (-20 cm of H_2O) applied to the chest tube. The interventional pulmonary and thoracic surgery teams assessed the suitability of each patient before finalizing the decision to implement an empyema tube.

For each patient, a narrow-bore pigtail chest tube was replaced by a standard chest tube under imaging guidance into the infected space. The tube was then cut in close proximity to the skin, and sterile metal clips were used to secure the tube and prevent dislodgement into the pleural space [Figure 1]. The end of the tube was covered with sterile gauze or an ostomy bag which was changed as needed, based on the amount of drainage. The patient was discharged and assessed in our clinic every 2 weeks. The tube was withdrawn 1–2 cm at each visit until the pleural space became progressively obliterated and the exudate dried up, or the empyema tube fell out without intervention.

Discharge instructions included avoidance of swimming, submerging, or exposing the end of the tube to water, and the patient was instructed to lie preferentially on the side of the empyema tube to aid gravitational drainage. Posteroanterior and lateral chest X-ray was obtained during each clinic visit to assess radiological improvement, and the patient was evaluated for worsening infection. Clinic visits were scheduled every 2 weeks for the first 6 months and every 4 weeks thereafter.

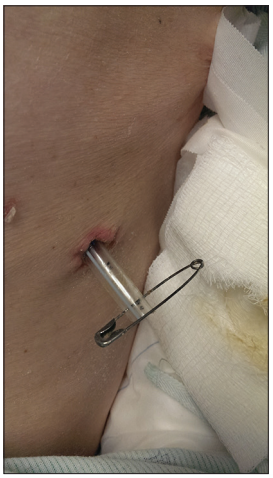

Figure 1: Empyema tube in position. Approximately 4 cm of the empyema-tube extends out of the chest wall with the rest still inside the pleural space. The metal clip prevents the tube from being dislodged into the pleural space. The tube is covered with a sterile gauze or with a colostomy bag based on the amount of drainage

RESULTS

Eight patients (six males, two females; four right, and four left), mean age 60.38 ± 6.07 (95% confidence interval [CI]) years, had a chest tube converted to an empyema tube [Figure 1 and Table 1]. Cancer was the most common comorbid condition encountered (six of eight patients). Two had primary metastatic lung cancer involving the ipsilateral lung, causing endobronchial obstruction and lung collapse. The average length of hospital stay was 15.50 ± 3.91 days (95% CI). The mean cumulative pleural fluid drainage was 3343.75 ± 662.72 mL (95% CI). Blood cultures were negative in all patients. Pleural fluid cultures were positive in seven of eight, with streptococci spp. and staphylococci spp. being the most prevalent species [Table 1]. The mean duration of antibiotic use was 37 ± 1.04 days (95% CI). Course and type of antibiotics were determined based on culture results after consultation with the infectious disease specialist. No patient developed secondary infection related to thoracostomy duration, nor did any require premature removal of the tube. The tube was removed after 73.62 ± 49.73 days (95% CI). One patient required the tube for 240 days; excluding him, the average duration of drainage was 49.85 ± 20.11 (95% CI) days. Tube sizes varied from 10Fr to 28Fr. No patients required a second chest tube.

One patient [No. 7, Table 1] had a slightly different clinical course. The patient underwent decortication but had incomplete resolution of the empyema after surgery. A repeat surgical procedure was considered very high risk; therefore, the chest tube was converted to an empyema tube. The empyema resolved after 20 days, and the tube was removed.

All of our patients had severe illness; functional class varied from Eastern Cooperative Oncology Group performance status 3–4. The American Society of Anesthesiology (ASA) class varied from ASA III to ASA IV. Despite their tenuous conditions, all of our patients experienced empyema resolution. Figures 2 and 3 show sequential radiographic follow-up on two separate patients with chronic empyema who initially had pigtail catheters placed for drainage. Once underlying unexpandable lung was identified, the pigtail catheters were exchanged for surgical chest tubes, which were then converted to empyema tubes and gradually withdrawn as described in the protocol above. We noted the subsequent progressive reduction in the size of the pleural cavity, which is eventually completely replaced with scarring and some degree of lung re-expansion, as seen in images posttube removal.

DISCUSSION

Despite recent advances, management of chronic empyema remains a challenge for modern medicine. The overall mortality is still high, and the best treatment remains to be defined.[15,16] When there is a healthy lung that can re-expand and the patient can tolerate a major operation, pulmonary decortication is the treatment of choice, with or without the use of video-assisted thoracoscopic surgery. However, the management of those patients deemed too unstable to undergo this procedure remains controversial. Most often, an OPW (Eloesser flap) procedure is performed.

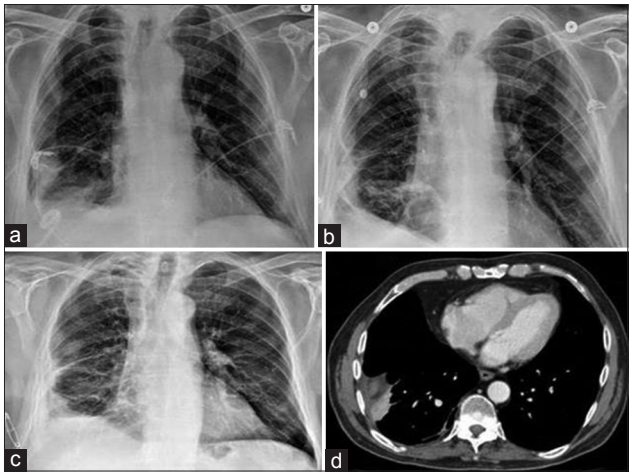

Figure 2: Sequential radiographs demonstrating gradual resolution of empyema. A pigtail is visible in the right empyema cavity (a). The pigtail has been replaced by a surgical chest tube in anticipation of discharge with an empyema tube (b). The chest tube has been converted into an empyema tube (c) and a clip has been placed over the chest tube to prevent the accidental retraction of the tube into the pleural space. The empyema cavity has resolved and the empyema tube has been removed (d). A small pleural scar has replaced the empyema cavity

Table 1: Characteristics of the eight patients included in the analysis

Patient number	Sex	Age (years)	LOS (days)	Volume pleural fluid (ml)	Blood culture result	Pleural fluid culture	Antibiotic duration (weeks)	Days with tube	Size of tube	ECOG status	Comorbidity
1	Male	54	10	5435	Negative	MSSA	7	72	28	3	SCC left lung
2	Female	58	20	3255	Negative	BHS	7	100	10	3	Metastatic breast cancer
3	Male	75	17	3315	Negative	MSSA	4	36	16	3	Lung abscess
4	Male	62	27	3670	Negative	MS	6	240	10	3	Laryngeal cancer
5	Male	54	12	3070	Negative	MS	6	34	20	4	Hepatitis C
6	Female	72	12	2165	Negative	Mixed	6	42	12	3	IPMN s/p whipple procedure
7	Male	51	14	3210	Negative	Negative	3	20	28	4	RCC
8	Male	57	12	2630	Negative	*Haemophilus influenzae*	6	45	28	3	Left endobronchial SCC

LOS: Length of stay, MSSA: Methicillin-sensitive *Staphylococcus aureus*, BHS: Beta-hemolytic streptococci, MS: Microaerophilic streptococci, Mixed: *Escherichia coli, Pseudomonas* sp. and *Enterobacter* sp., SCC: Squamous cell cancer, IPMN: Intraductal papillary-mucinous cancer of the pancreas, RCC: Renal cell cancer, ECOG: Eastern Cooperative Oncology Group

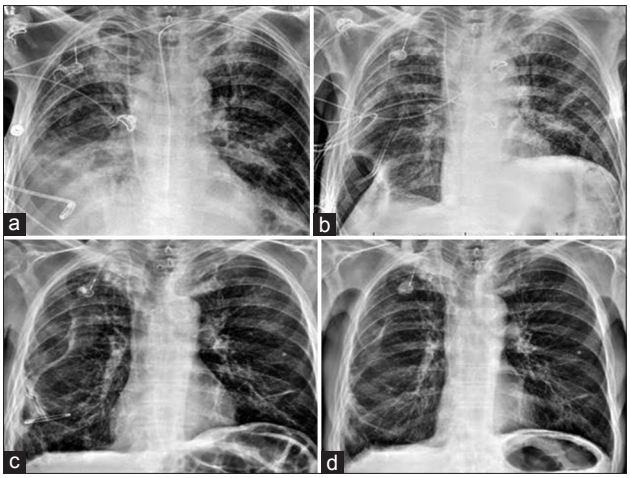

Figure 3: A pigtail has been placed to drain the right-sided empyema (a). The pigtail has been replaced with a surgical chest tube; the pus has been mostly drained and a hydropneumothorax remains (b). The chest tube is cut close to the skin surface and a clip applied to it to prevent accidental retraction of the tube into the pleural space (c). The empyema tube has been removed (d). A linear vertical pleural scar remains as a result of the empyema, but the infection has been controlled along with expansion of the ipsilateral lung

Approximately, 6–20 cm of two to four ribs is usually resected during this procedure, creating a large defect in the chest wall.[3,9-11] Although effective for the treatment of chronic empyema, major resection of the chest wall induced by an OPW should, in our opinion, be avoided. We feel especially strongly about this considering the current global trend toward minimally invasive operations. Another proposed management option, the POP, involves a surgical procedure under general anesthesia where the prosthesis is introduced in the intercostal space with about 2 cm of the tube protruding from the chest wall. These patients may need thoracoscopic guidance and adhesiolysis before the prosthesis can be correctly placed.[12] The POP procedure is not routinely performed and the prosthesis is not ubiquitously available, nor is it currently available in the United States. Due to significant morbidity, mortality, and nonavailability of open pleural drainage options mentioned above, many patients experience prolonged hospital stays with a draining chest tube, where they are susceptible to health-care associated infections, increased medical costs, and reduced quality of life.

We, in the form of this current case series, report our experience in management of these complex patients by converting the chest tube localized in the infected space with image guidance, into an "empyema-tube," by cutting and securing the end of the tube. Prior to executing this management option, we confirm the presence of chronic empyema, unexpandable lung, and high surgical risk. Our study demonstrates that empyema tube drainage is simple, safe, well-tolerated, and effective. It also allows for earlier hospital discharge. We observed no morbidity or mortality attributed directly to the empyema tube. Results from our study are comparable to those of a POP procedure and OPW surgery in terms of treatment efficacy.[11,17-19] Additionally, use of an empyema tube offers advantages over conventional approaches in that it is placed under local anesthesia, does not require a prolonged surgery, and avoids postoperative pain and other potential complications. A significant advantage for the patient is that empyema tube drainage precludes major chest wall resection, thus avoiding gross esthetic compromise.

Among all patients in our series, the residual pleural space was replenished by fibrous tissue with some degree of lung re-expansion, and the empyema-tube was removed in 1–6 months. Although none of our patients underwent pleural space obliteration procedures, empyema-tubes can potentially be used as a bridge to thoracoplasty and muscle or omental transposition surgeries.

Some limitations of our study worth highlighting are its retrospective nature and small sample size. We also did not employ any quality of life questionnaires to assess superiority of empyema tube to OPW drainage. Our experience, however, demonstrated that empyema tubes allowed drainage of the infected space and pleural healing with complete success. In this clinical scenario where treatment options are limited and often dismal, such a result is quite welcome. We, therefore, believe that chronic empyema can now be treated with a much less invasive and nondeforming operation, with the same result as conventional surgical techniques. Empyema tube drainage provides a practical solution for managing extremely debilitated and marginal surgical candidates because of the simplicity of its design and effectiveness in helping with infection control, and could be considered a first-line management option for patients with chronic empyema, unexpandable lung, and poor surgical candidacy.

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Nil.

Conflicts of interest
There are no conflicts of interest.

CONCLUSION

This study identifies a nonsurgical, minimally invasive method to treat chronic empyema in patients who are not candidates for decortication or other forms of definitive surgery. The procedure is safe, obviates the need for surgical intervention, and can be performed without extensive training. It shortens hospital stays, expedites the patient's return to a normal lifestyle, and is free of major side effects.

REFERENCES

1. Light RW. Parapneumonic effusions and empyema. Proc Am Thorac Soc 2006;3:75-80.

2. Deslauriers J, Mehran R. Handbook of Perioperative Care in General Thoracic Surgery. 1st ed. Philadelphia, Pennsylvania: Mosby; 2005.
3. Molnar TF. Current surgical treatment of thoracic empyema in adults. Eur J Cardiothorac Surg 2007;32:422-30.
4. Andrews N. Management of nontuberculous empyema: A statement the subcommittee on surgery. Am Rev Respir Dis 1962;85:935-6.
5. Wozniak CJ, Paull DE, Moezzi JE, Scott RP, Anstadt MP, York VV, *et al*. Choice of first intervention is related to outcomes in the management of empyema. Ann Thorac Surg 2009;87:1525-30.
6. Luh SP, Chou MC, Wang LS, Chen JY, Tsai TP. Video-assisted thoracoscopic surgery in the treatment of complicated parapneumonic effusions or empyemas: Outcome of 234 patients. Chest 2005;127:1427-32.
7. Kim BY, Oh BS, Jang WC, Min YI, Park YK, Park JC. Video-assisted thoracoscopic decortication for management of postpneumonic pleural empyema. Am J Surg 2004;188:321-4.
8. Edaigbini S, Anumenechi N, Odigie V, Khalid L, Ibrahim A. Open drainage for chronic empyema thoracis; clarifying misconceptions by report of two cases and review of literature. Arch Int Surg 2013;3:161.
9. Jacques L, Deslauriers J. Open drainage. Thorac Surg 1995;1:1136-9.
10. Postmus PE, Kerstjens JM, de Boer WJ, Homan van der Heide JN, Koëter GH. Treatment of post pneumonectomy pleural empyema by open window thoracostomy. Eur Respir J 1989;2:853-5.
11. Galvin IF, Gibbons JR, Maghout MH. Bronchopleural fistula. A novel type of window thoracostomy. J Thorac Cardiovasc Surg 1988;96:433-5.
12. Filomeno LT, Campos JR, Machuca TN, das Neves-Pereira JC, Terra RM. Prosthesis for open pleurostomy (POP): Management for chronic empyemas. Clinics (Sao Paulo) 2009;64:203-8.
13. Egri G, Krishnadas R, Froeschle P. Indwelling pleural catheter insertion following inefficient thoracoscopic decortication in postpneumonic empyema: Beneficial or contraindicated? Open J Thorac Surg 2013;3:123-6.
14. Davies HE, Rahman NM, Parker RJ, Davies RJ. Use of indwelling pleural catheters for chronic pleural infection. Chest 2008;133:546-9.
15. Lee SF, Lawrence D, Booth H, Morris-Jones S, Macrae B, Zumla A. Thoracic empyema: Current opinions in medical and surgical management. Curr Opin Pulm Med 2010;16:194-200.
16. Kern L, Robert J, Brutsche M. Management of parapneumonic effusion and empyema: Medical thoracoscopy and surgical approach. Respiration 2011;82:193-6.
17. Smolle-Jüttner F, Beuster W, Pinter H, Pierer G, Pongratz M, Friehs G. Open-window thoracostomy in pleural empyema. Eur J Cardiothorac Surg 1992;6:635-8.
18. Katsuragi N, Nakajima Y, Shiraishi Y, Hashizume M, Takahashi N. Chronic tuberculous methicillin-resistant *Staphylococcus aureus* (MRSA) empyema with bronchopleural fistulae treated by open window thoracostomy followed by thoracoplasty and latissimus dorsi muscle transposition. Kyobu Geka 2005;58:1121-4.
19. Filomeno LT, de Campos JM, de Almeida AW, Werebe Ede C, Jatene FB, Leirner AA. A dedicated prosthesis for open thoracostomy. Ann Thorac Surg 1997;63:1494-6.