Tunneled Pleural Catheters for Patients With Chronic Pleural Infection and Nonexpandable Lung

Adnan Majid, MD, FCCP, Andres de Lima, MD,* Mihir Parikh, MD,* Alex Chee, MD, FCCP,* Sebastian Fernandez-Bussy, MD,† and Fayez Kheir, MD, MSc*‡*

Summary: **Chronic pleural infection is characterized by thickened pleura and nonexpandable lung often requiring definitive surgical intervention, such as decortication and/or pleural obliteration procedures. Such procedures are associated with significant morbidity and require proper patient selection for a successful outcome. We report a cohort of 11 patients with pleural space infection and a nonexpandable lung treated with tunneled pleural catheters (TPCs). Following placement, hospital discharge and TPC removal occurred after a median of 5 and 36 days, respectively. Three patients presented with residual loculated effusion that resolved with instillation of intrapleural fibrinolytic therapy. One patient eventually required open window thoracostomy for ongoing pleural infection due to poor medical compliance with TPC care and drainage instructions. TPCs represent an alternative option for drainage of an infected pleural space in nonsurgical candidates with a nonexpandable lung. Their use, as a compliment to traditional treatment, may facilitate prompt hospital discharge and ambulatory management in patients with limited life expectancy.**

Key Words: chronic pleural infection, tunneled pleural catheters, non-expandable lung

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Pleural space infection is a highly prevalent condition that is associated with substantial morbidity, mortality, and increased hospital costs.[1–3] Surgical management with decortication and/or pleural obliteration procedures (thoracoplasty and muscle flap transposition) is often required in patients with chronic pleural infection and nonexpandable lung.[3–6] These are highly invasive procedures requiring patients to tolerate prolonged surgical time and single lung ventilation.[5] These procedures are also associated with increased hospital stay,[6] significant mortality (3.4%) and morbidity, including air leaks (2.6%), hemorrhage (3.0%), wound infection (2.6%), and need for reintervention or further drainage (6.8%).[7] Hence, patients with chronic pleural infection and a nonexpandable lung, who are considered unfit for a major surgical procedure, have limited treatment options, such as open window thoracostomy (ie, Clagett window or Eloesser flap).[8,9] Unfortunately, these procedures are associated with significant morbidity (reported between 5% and 18%), decreased quality of life, chest-wall deformity, and chronic pain.[8,10–12]

"Empyema tubes" (cutting the tube near the skin and securing the end with a sterile clip to allow for open pleural drainage) have been proposed as an alternative to chronically drain the pleural space in this population in a recent case series of 8 patients.[13] Despite limited evidence, tunneled pleural catheters (TPCs) may represent an alternative, since it offers better patient quality of life (tube not attached continuously to a drainage system) and higher patient safety (as TPCs are unlikely to dislodge).[14] Hence, these devices could represent a feasible alternative for long-term pleural drainage for this patient population.[15,16]

We report our experience using TPCs as an alternative to drain (and obliterate) residual pleural space in patients with pleural infection and nonexpandable lung.

METHODS

Study Description

A retrospective study was conducted at Beth Israel Deaconess Medical Center (IRB 2015P000008) with a waiver of consent. Consecutive patients with

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From the *Division of Thoracic Surgery and Interventional Pulmonology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA; ‡Division of Pulmonary Diseases, Critical Care, and Environmental Medicine, Tulane University Health Sciences Center, New Orleans, LA; and †Section of Interventional Pulmonology, Clinical Alemana, Universidad del Desarrollo, Santiago, Chile.
A.M. and A.D.L. contributed equally.
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Reprints: Fayez Kheir, MD, MSc, Director of Interventional Pulmonology, Assistant Professor of Medicine, Tulane University School of Medicine, 1430 Tulane Avenue, Box 8509, New Orleans, LA 70112 (e-mail: fkheir@tulane.edu).

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a history of pleural infection and a nonexpandable lung treated with TPC placement were included in this study. A total of 1054 cases were identified by searching hospital billing records for CPT codes related to TPC insertion (32550) between January 2010 and March 2018. Following the revision of records, 11 patients were identified of having TPC placed due to pleural infection with ICD codes: ICD-10: J86.9 and J86.0/ICD-9: 510.9 and 510.0. Records were reviewed for patient demographics, comorbidities, microorganism isolated from pleural fluid, TPC insertion technique, number of days between TPC insertion and discharge, number of days between TPC insertion and removal, and number of days until latest medical follow-up. Complications were also recorded.

Patient Selection

All patients with proven pleural infection had been treated per protocol with antibiotics, tube thoracostomy and intrapleural fibrinolytic therapy (tissue plasminogen activator and deoxyribonuclease) as described previously[17] and as per protocol followed at our center. Patients were considered for TPC if they had (1) clinical evidence of a persistent pleural infection, (2) radiologic evidence of a nonexpandable lung on chest imaging, and (3) poor candidacy for major surgery (decortication) as determined by our thoracic surgery team or declined surgery.

Operative Techniques

Eight patients had the TPC placed at bedside under sonographic guidance using a modified Seldinger technique.

Three patients had the TPC placed under thoracoscopy (medical, n = 2 and video assisted, n = 1) as they required mechanical debridement of pleural space since they did not adequately respond to intrapleural fibrinolytic therapy. None of these patients were candidates for decortication: either due to limited life expectancy (patient 8) or because they declined more invasive surgery beside mechanical debridement (patients 5 and 11). During these procedures, interventions were limited to pleural adhesiolysis and pleural space washout with further tunneling and insertion of TPC. Following TPC placement, patients were instructed to drain the TPC daily and were scheduled for outpatient follow-up in 2 to 3 weeks. Antibiotic therapy was continued in the ambulatory setting for 4 to 6 weeks based on individual antibiogram susceptibility results. The TPC was removed in the interventional pulmonary outpatient clinic after clinical improvement, the catheter drainage was <50 mL per day for 3 consecutive days and chest imaging (chest ultrasound and/or computed tomography) showed <200 mL of residual pleural fluid. The fluid volume on ultrasound was calculated by measuring the interpleural distance at maximum inspiration. The measurement is made above the diaphragm's superior margin with a distance of <15-mm extension corresponds to an average volume of ≤200 mL.[18] The pleural effusion volume was quantified using the OsiriX digital analysis program (OsiriX Imaging Software, v3.6.1; OsiriX Foundation, Geneva, Switzerland) reconstructed from patients' chest computed tomographic scanning images as described previously by our group.[17] Descriptive statistics were used to describe patient demographics and outcomes.

RESULTS

Eleven patients (7 men and 4 women) were included with median age 70 years. The baseline demographic, clinical, medical comorbidities and microbiological characteristics of the patients are shown in (Table 1).

The median time between TPC insertion and hospital discharge was 5 days. Seven patients had the TPC removed within a median of 36 days. Three patients passed away with the TPC due to their terminal illness without TPC-related complications. One patient was seen for 45 days following TPC placement and then was lost to follow-up (Table 2).

Three patients had residual loculated pleural effusions after TPC placement which resolved with intrapleural fibrinolytic therapy. One patient had soft tissue infection at the site of catheter insertion along with worsening pleural space infection. Unfortunately, this patient was noncompliant with TPC management (daily drainage, proper hygiene on catheter insertion site, and close outpatient follow-up). The combination of these factors was deemed as the cause for soft tissue infection and further TPC failure. This patient underwent open window thoracostomy (Table 2).

DISCUSSION

TPCs are being increasingly used in clinical practice as a minimally invasive method to drain recurrent malignant pleural effusions. Pleural space infection is regarded as an indication to remove TPC if such an infection is not adequately controlled with drainage and antibiotics. However, a small case series reported that such drainage catheters were used to successfully drain complicated pleural space infections in patients

TABLE 1. Demographics and Clinical Characteristics

Subjects	Sex	Age	Comorbidities	Microorganism Isolated
1	F	83	Advanced non–small-cell carcinoma of the lung Type 2 diabetes mellitus Hypertension Hypothyroidism	*Staphylococcus aureus*
2	M	95	Atrial fibrillation End-stage renal disease Coronary artery disease	None
3	M	56	Advanced non–small-cell carcinoma of the lung	*Streptococcus anginosus*
4	M	55	Small-cell carcinoma of the lung Hypertension Dyslipidemia Gout	*Streptococcus pneumoniae*
5	M	71	Coronary artery disease Chronic obstructive pulmonary disease Abdominal aortic aneurysm	*Staphylococcus aureus*
6	M	70	End-stage liver disease Septic shock	None
7	F	43	HIV/AIDS End-stage liver disease	*Candida tropicalis* *Candida dubliniensis*
8	F	82	Advanced non–small-cell carcinoma of the lung Deep venous thrombosis	*Streptococcus pneumoniae*
9	M	61	End-stage liver disease Declined surgical decortication	*Escherichia coli*
10	M	78	End-stage liver disease Chronic lymphocytic leukemia	*Staphylococcus aureus*
11	F	85	Hypertension Community-acquired pneumonia	*Fusobacterium spp.*

F indicates female; M, male

with a nonexpandable lung.[15,16] We expand on this evidence, by reporting our experience using TPCs as an alternative to chronically drain an infected pleural space in a selected patient population (Fig. 1). This modality is comparable with empyema tubes. However, the advantages

TABLE 2. TPC Placement Characteristics and Outcomes

Subjects	Method for TPC Placement	Days Between TPC Insertion and D/C	Days Between TPC Insertion and Removal	TPC-related Complications
1	Ultrasound	6	10*	None
2	Ultrasound	1	62	Residual loculated effusion required single-dose fibrinolytic therapy (ambulatory)
3	Ultrasound	5	109*	None
4	Ultrasound	2	57	Residual loculated effusion required 3 doses of fibrinolytic therapy (inpatient for 2 d)
5	VATS	6	33*	None
6	Ultrasound	26†	26	None
7	Ultrasound	3	36	None
8	Medical thoracoscopy	3	16	Residual loculated effusion required single-dose fibrinolytic therapy (ambulatory)
9	Ultrasound	7	168‡	Failed therapy. Underwent open window thoracostomy
10	Ultrasound	10	45§	None
11	Medical thoracoscopy	2	31	None

*Patient passed away with TPC in place. Denotes the number of days between TPC insertion and last follow-up before patient demise.
†Stayed in the hospital due to other medical issues unrelated to catheter insertion.
‡TPC removed due to failure, the patient underwent decortication and Clagett window creation.
§Loss of follow-up. Denotes the number of days between TPC insertion and latest patient follow-up date.
TPC indicates tunneled pleural catheter.

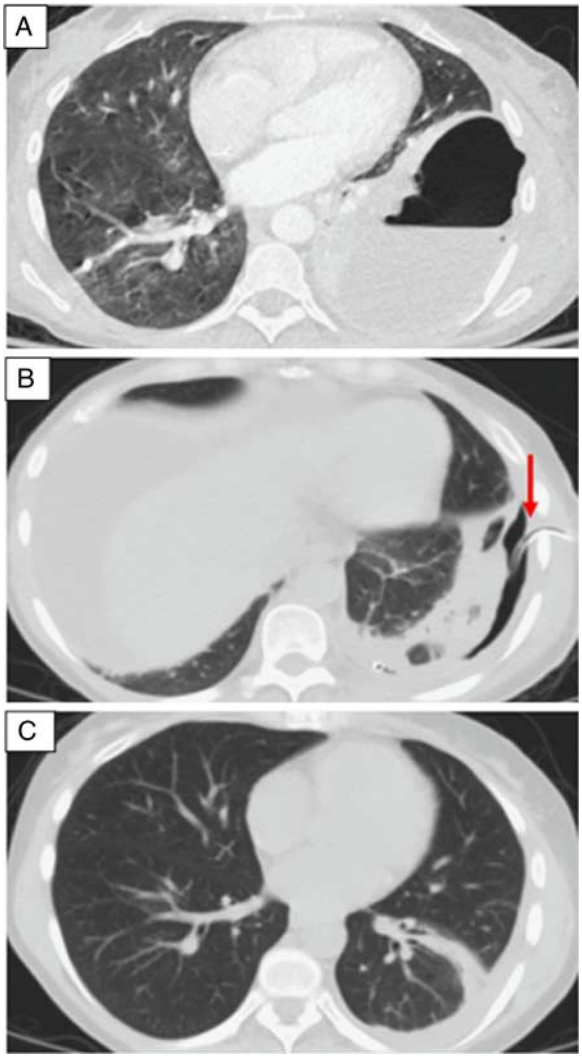

FIGURE 1. Chest computed tomographic scanning images showing pleural space infection and a nonexpandable lung, managed with medical treatment and TPC drainage. A, Image upon admission. B, TPC in place (red arrow), after 18 days of therapy initiation. C, Resolution of the infection after 68 days following therapy and TPC removal. TPC indicates tunneled pleural catheter.

of TPC approach is that (1) it is more securely attached to the patient via the cuff without fear of chest tube dislodgement, (2) more convenient to apply intermittent suction to it via the evacuated drainage bottles, and (3) more comfortable to the patient than a traditional tube. Such treatment may favor earlier hospital discharge and eventual infection resolution with ambulatory management and close outpatient follow-up. This may be particularly valuable in the setting of terminally ill patients, as it may allow this population to spend their last days away from a hospital despite the existence of pleural space infection as well as in patients not considered fit for a decortication or decline an open window thoracostomy.

Appropriate patient education with regard to TPC, outpatient clinical follow-up, and patient's ability to properly care for the catheter is fundamental to achieve adequate treatment goals with this technique. If these circumstances cannot be secured, more definitive treatment alternative, such as an open window thoracostomy should be pursued as demonstrated by one patient in our cohort who was noncompliant.

This study has limitations. This was a retrospective case series with a small sample size that needs to be validated in a large multicenter study.

TPCs are a minimally invasive alternative that may effectively drain chronic pleural space infections in a selected group of patients with a nonexpandable lung in whom invasive treatment options that include surgical decortication are not feasible or not desired.

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