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Case Report

Intrapleural Urokinase to Treat Organized Empyema Thoracis After Failure of VATS Debridement

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Abstract

Empyema thoracis is a complex pleural infection disease that can evolve into three pathological phases: exudative, fibrinopurulent, and organized. Each stage presents with its own characteristics and relevant treatment strategies. Organized empyema, defined as pleural fibrosis with peel formation, often requires thoracotomy and decortication to expand the entrapped lung. In chronically ill, debilitated, or elderly patients superimposed with organized empyema, more invasive operative approaches are likely to result in higher procedure-related morbidities and mortalities. On the other hand, less invasive procedures would also be inappropriate because of frequently ineffective drainage or consistent lung encasement (e.g. prolonged catheter insertion, intrapleural fibrinolysis, or thoracoscopic debridement). Here, we report two elderly patients with concomitant illnesses who developed organized empyema and had no response to nonoperative management. Both patients recovered completely after video-assisted thoracoscopic surgery debridement, proper chest tube placement, and urokinase instillation to resolve residual thick peels. Less invasive surgical treatment combined with the use of fibrinolytic agents may be an option in treating patients with organized empyema who cannot tolerate decortication. (*Tzu Chi Med J* 2009;21(3):255–260)

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1. Introduction

Empyema thoracis remains a frequently encountered clinical problem. If adequate drainage of the pleural space in the exudative, fibrinopurulent or organized phases is not prompt and effective, the patient will often experience prolonged hospitalization, development of systemic toxicity, increased morbidity from drainage procedures, increased risk of residual ventilatory impairment, and increased mortality (1). The optimal treatment of pleural empyema has been widely debated, and therapeutic approaches differ between physicians ranging from thoracentesis, tube thoracostomy drainage, drainage plus intrapleural instillation of fibrinolytic agents, video-assisted thoracoscopic surgery (VATS), and surgery with or without

decortication and rib resection [1]. In general, if drainage is incomplete due to the infection location, intrapleural fibrinolytic drugs should be supplied, or thoracoscopic debridement conducted. If the lung does not re-expand completely because of pleural peel formation, decortication should be carried out without delay [2]. Up to 40% of empyema patients come to surgery because of failed catheter drainage and, overall, 20% of patients with empyema die. Rapid evaluation of its status and proper therapeutic intervention appear to reduce morbidity and mortality, as well as healthcare costs [3]. The key to successful treatment lies in effective pleural evacuation and re-expansion of the lung. In the late organized stage of empyema thoracis—accompanied by thick peel formation and an entrapped lung—open decortication is considered the most appropriate treatment in terms of efficacy and length of hospital stay [4]. Here, we present two patients in which organized empyema thoracis was successfully managed with VATS debridement followed by the use of intrapleural fibrinolysis.

2. Case reports

2.1. Case 1

A 72-year-old man presented with fever, productive cough, and shortness of breath for about 1 week. He had a history of gastroesophageal reflux disease and chronic hepatitis C without regular treatment. Years before presentation, he received craniotomy (for right cerebellar hemangioblastoma) and a ventriculoperitoneal shunt (for hydrocephalus formation). Acute respiratory failure occurred after the operation and tracheostomy was then performed. During hospitalization, he developed rhonchi of the left lung and copious thick yellowish sputum from the tracheostomy tube. Chest radiography showed a pneumonic patch in the left lower lobe (Fig. 1A) and leukocytosis (13,470/μL) was observed. Despite early use of broad-spectrum antibiotics, his pneumonia rapidly progressed to a huge loculated effusion occupying nearly the entire left pleural cavity with midline shifting on the following chest films (Fig. 1B). Pigtail catheter drainage (14F inter-V; PBN Medicals A/S, Stenløse, Denmark) under ultrasound guidance was carried out to disclose turbid fluid and increased echogenicity, compatible with the multiloculated fluid collections with encapsulation detected on chest computed tomography (CT) scan (Fig. 1C). With no improvement of his symptoms and inadequate drainage by the pigtail catheter (Fig. 1D), VATS under general anesthesia was undertaken 2 weeks later, revealing thick peels overlying both pleurae. Bleeding occurred readily on contact during instrumental debridement of the deposited necrotic tissue and constrictive hard rinds via the thoracoscopic working channel—this made it impossible to proceed with the decortication procedure. One 28-Fr chest tube (P.V.C. thoracic catheter; Sewoon Medical Co. Ltd, Seoul, Korea) was then placed through the port and another 28-Fr chest tube was put separately into the upper part of the encapsulated empyema cavity during the operation to increase drainage and to make later fibrinolysis of the tight peels more feasible. Postoperative chest radiography showed diffuse thick peels hampering the left lung and formation of a huge cavity after negative pressure was applied to the chest tubes (Fig. 1E). Therefore, we started fibrinolytic therapy, instilling urokinase 120 KIU (urokinase-GCBT 250 KIU/vial; Korea Green Cross Corp., Gyeonggi, Korea), mixed with 100 mL of normal saline, into the pleural cavity through the upper chest tube, followed by clamping of both tubes and postural changes of the patient for 2 hours. The procedure was repeated on alternate days for a total of six treatments. There was constant putrid fluid drainage from the dependent tube after initial clamping and no hemorrhagic complications occurred. The upper chest tube was removed 3 weeks postoperatively and the patient was discharged with the lower tube in place for open drainage. The tube was gradually pulled out and the patient completely recovered with full expansion of the left lung 3 months later (Fig. 1F).

2.2. Case 2

An 81-year-old man presented with chest pain and cough with yellowish sticky sputum for 2 weeks. High fever with intercurrent chills also developed 2 days before admission. He had a history of hypertension and type II diabetes mellitus for more than 20 years and received medications irregularly. Leukocytosis (21,420/μL) was observed and initial chest radiography showed interstitial infiltrations over the right lower lobe that was diagnosed as pneumonia; empirical antibiotics were then prescribed. A CT scan demonstrated basal lung consolidation and partial collapse of the right lower lobe with a loculated parapneumonic pleural effusion (Fig. 2A), compatible with the findings of septate fluid collections on thoracic ultrasound (Fig. 2B). Pleural tapping and pigtail catheter drainage (14F inter-V; PBN Medicals A/S)—guided by ultrasound—were performed. The aspirated yellowish fluid yielded no growth on bacterial culture. However, the encapsulated effusion rapidly enlarged with interlobar extension on chest radiography (Fig. 2C). VATS was then conducted under general anesthesia using a double-lumen endotracheal tube. The right lung densely adhered to the chest wall with the lower lobe severely encased by thick peel and necrotic tissue. This was found particularly at the costophrenic angle

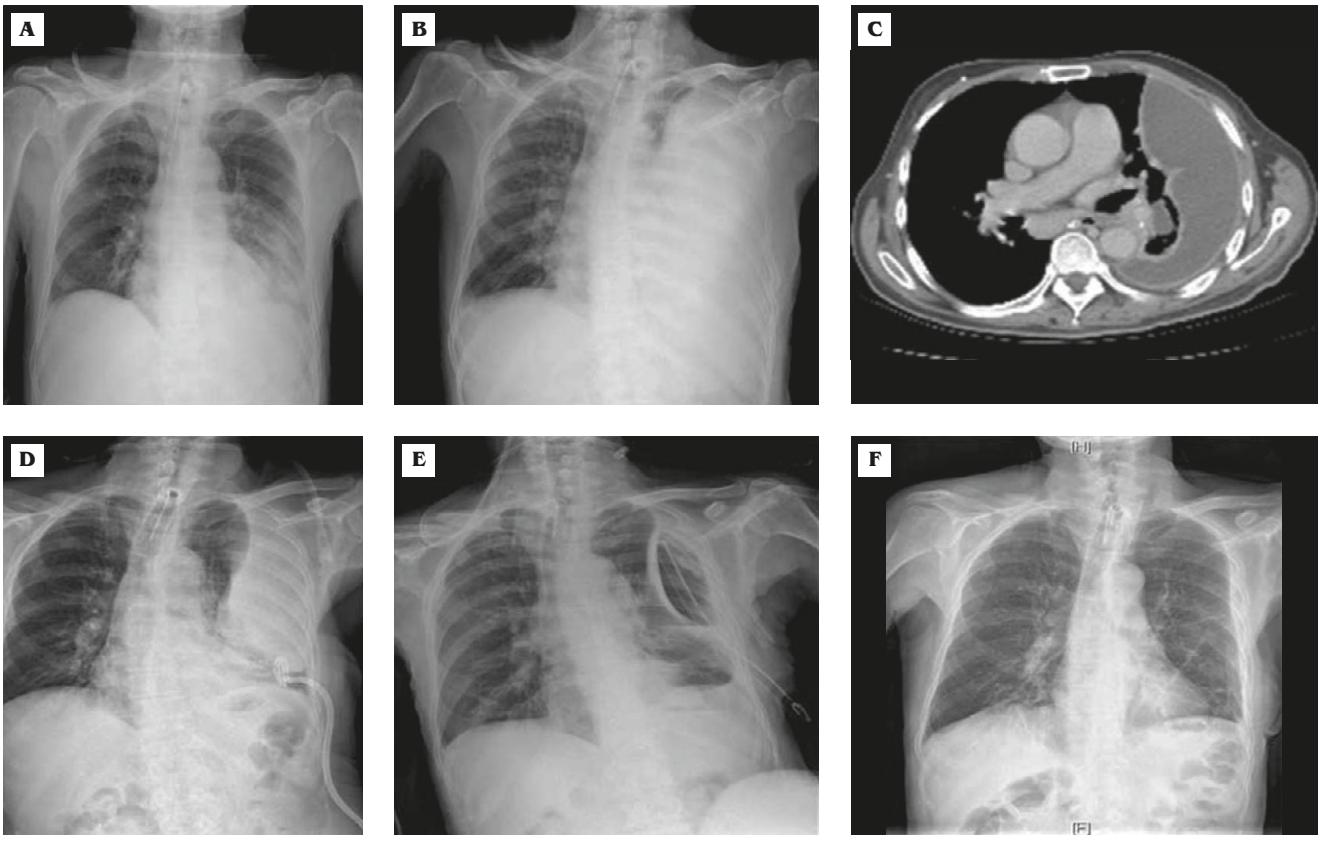

Fig. 1 — (A) Chest radiography at presentation shows a pneumonic patch over the left lower lobe and a tracheostomy tube in place. (B) A huge encapsulated pleural effusion occupying nearly the entire left pleural cavity, with the midline shift seen on subsequent chest radiography. (C) Chest computed tomography scan demonstrates encapsulated fluid collection and partial collapse of the left lung. (D) Chest radiography shows inadequate drainage following pigtail catheter insertion. (E) Diffuse thick peel hampering the left lung and huge cavity formation after chest tube drainage. (F) Chest radiography 3 months after surgery shows re-expansion of the left lung.

and diaphragmatic region, where a foul-smelling putrid fluid accumulation was also found. Instrumental debridement of the overlying necrotic tissue via the thoracoscopic working channel was done as adequately as possible. One 32-Fr chest tube (P.V.C. thoracic catheter; Sewoon Medical Co. Ltd.) was inserted via the port with part of the encompassed hard peels remaining. The fever subsided after the operation and the patient received intrapleural urokinase treatment (urokinase-GCBT 250 KIU/vial; Korea Green Cross Corp.) once per day for 3 consecutive days. Each treatment consisted of urokinase 120 KIU in 100 mL of normal saline administered via the chest tube, followed by clamping of the tube for 2 hours. The patient's total hospital stay was 3 weeks. The chest tube was removed prior to discharge with complete expansion of the right lung (Fig. 2D).

3. Discussion

We reported two elderly, debilitated patients who developed pleural infections that evolved into the organized phase of empyema thoracis. Both patients had complete recoveries after VATS with one-port thoracoscopic debridement, followed by intrapleural urokinase fibrinolytic therapy.

Empyema thoracis is a common disease entity and frequently develops in chronically ill, debilitated, or immunocompromised patients with various underlying comorbidities. It can progress very rapidly as in our patients, and, if diagnosis or treatment is delayed, may be associated with prolonged hospital stay and increased morbidity and mortality (2). The therapeutic options including antibiotics, thoracentesis, chest intubation, fibrinolytic therapy, VATS, and open thoracotomy may vary depending on the stage of the disease (5). VATS debridement is considered a primary treatment strategy in the fibrin purulent phase of the illness with respect to treatment efficacy, hospital duration, duration of chest tube placement, and the need for subsequent procedures (6,7). Early decortication by VATS or thoracotomy is suggested for both adults and children who develop organized empyema thoracis associated with formation of a thick fibrinous peel. It achieves proper lung

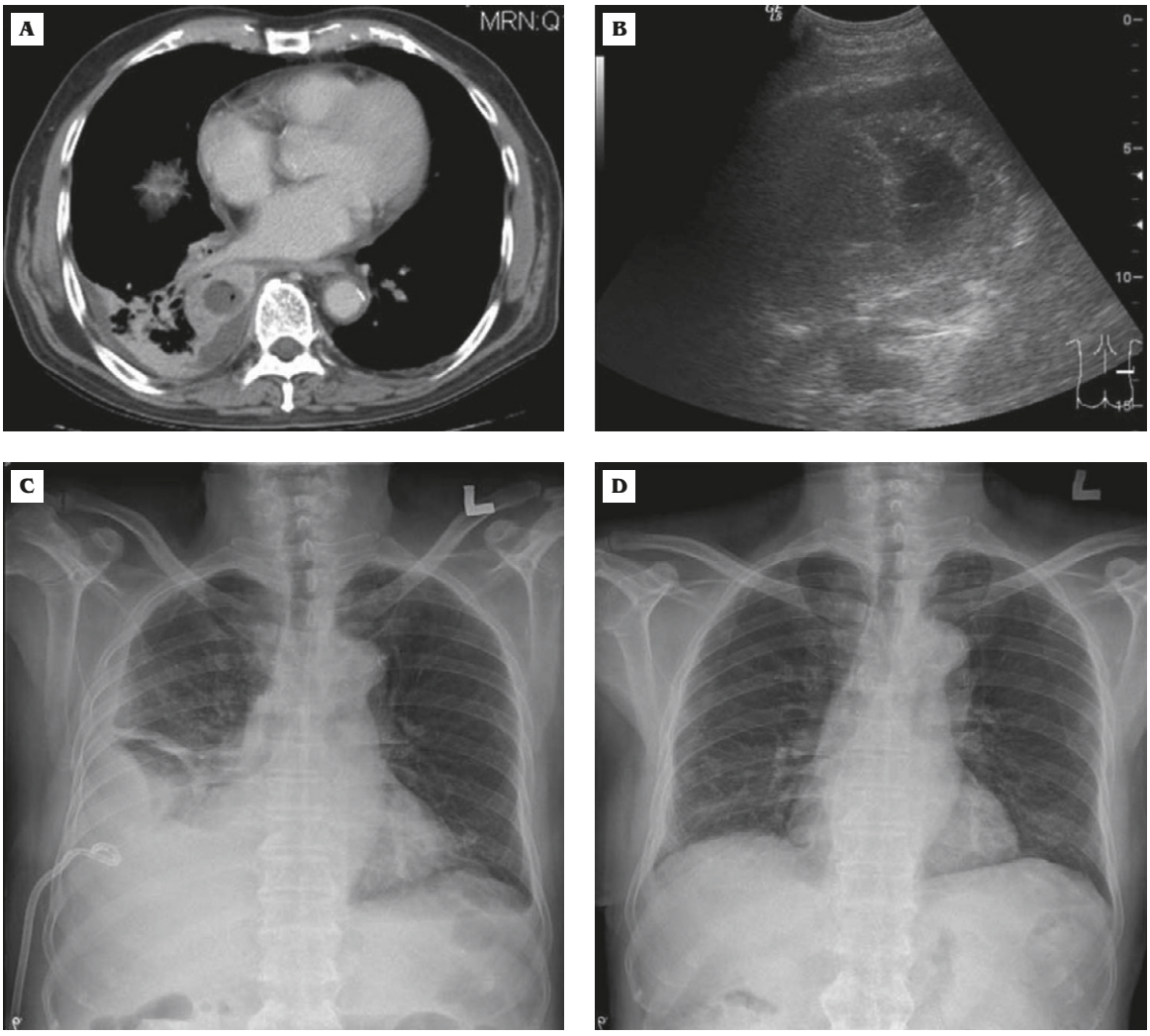

Fig. 2 — (A) Computed tomography demonstrates consolidation of the right lower lobe with multiloculated parapneumonic pleural effusion. (B) Ultrasound findings of septate fluid collections. Chest radiography shows: (C) enlarging loculated effusion with interlobar extension after pigtail catheter drainage; (D) full expansion of the right lung after chest tube removal.

re-expansion, and decreases hospital stay and total health costs [5,8]. For chronic or complicated empyema, partial rib resection and chest wall muscle flap application [9] has been proposed as a safe and definitive surgical procedure, although it often results in higher morbidity and prolonged recovery time.

Since the 1990s, fibrinolysis and early VATS have emerged as two new treatment modalities for thoracic empyema. Many institutions are now using one of these methods as first-line therapy because they result in shorter hospital stay and fewer complications than the conservative approach [10]. Moreover, nearly half of patients with sonographically stratified multiloculated empyema need intrapleural fibrinolysis after thoracoscopic debridement to achieve satisfactory results [11]. In the organized stage of empyema thoracis—complicated by multiloculated pleural effusion or pus collection—as in both of our patients, open decortication is the most appropriate method to clear the thick constrictive rind overlying the pleurae [4]. However, we attempted thoracoscopic debridement instead of the more invasive procedure to minimize postoperative events in these elderly, debilitated patients. In fact, bleeding occurred even during thoracoscopic manipulation in our first patient. The use of VATS debridement alone was obviously inadequate for clearing the peels and re-expanding the lung; conversion to open decortication was also not feasible, so we decided to treat the residual thick peel later with fibrinolytic therapy.

Pigtail tube drainage—guided by chest ultrasound—is often used as an initial step for the management of infected intrapleural fluid collections, but it often fails due to tube kinking, malposition, or blockage [12].

This leads to clinical and radiographic deterioration, as exemplified in the patients described in this study. One-port thoracoscopy—with instrument insertion through the working channel of the scope and video monitoring assistance—is an alternative for thorough deloculation and debridement. It is particularly useful for deposited necrotic tissue and fibrinous peel coating. The small port wound can also be used for chest tube insertion. We believe this approach is less invasive and better tolerated, with good therapeutic results and minimal postoperative complications. It is at least as effective as VATS, which involves more ports. In cases where thoracoscopy discloses extensive thick peel formation hampering most of the diseased lung, which limits the procedure to incomplete debridement of the space, we may still be able to administer intrapleural urokinase postoperatively to expand the underlying entrapped lung.

Intrapleural fibrinolytic therapy using agents such as streptokinase, urokinase, or tissue plasminogen activator may lyse the fibrinous strands and thereby clear the lymphatic pores—this is recommended for any complicated parapneumonic effusion or empyema [13,14]. Cumulative evidence suggests that these agents are more effective and safer in children than in adults, although intrapleural administration of streptokinase does not improve mortality, the rate of surgery, or the length of the hospital stay of patients with pleural infection [15,16]. It was reported that about 21–31% of patients with empyema thoracis who underwent fibrinolytic therapy failed to respond clinically or radiographically and only recovered after open thoracotomy, although no major complications or mortality occurred during fibrinolysis [17,18]. In both of our patients, however, the remaining intrapleural peels were completely resolved eventually without any sequelae after using urokinase instilled through the chest tube. We think this treatment modality is a safe and effective way to increase pleural circulation and chest tube drainage without causing systemic fibrinolysis. It is indicated if there is unsatisfactory radiographic improvement even with constant drainage or after inadequate VATS debridement of empyema thoracis. In our second patient, it may have contributed to full lung expansion when combined with thoracoscopic management.

Although an indwelling pleural catheter has been suggested to treat chronic pleural infection [19], we prefer to use a large-bore chest tube both for adequate drainage when connected (if necessary) to a negative-pressure suction device, and for later fibrinolytic therapy in this specific stage of empyema thoracis. We believe it can also shorten the protracted clinical course and achieve the goal of complete expansion of the entrapped lung, which is particularly important in these patients. Our first patient was even discharged with open chest tube drainage for the residual pus, and the tube was eventually removed uneventfully. Our method provides another option in treating patients with organized empyema thoracis who are considered poor surgical candidates. It results in only a small thoracostomy wound and causes less postoperative pain and procedure-related morbidity than open decortication. In addition, intrapleural urokinase fibrinolytic therapy appears to be an optimal strategy to preserve lung function and spare patients the morbidity and mortality risk of a thoracotomy. Further study with more patients is needed to determine whether it results in early recovery, less antibiotic coverage, and a better quality of life in these patients.

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