

Surgical Treatment for Acute Lung Abscess Secondary to Lung Cancer: A Case Report

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Received: 12 Oct 2022

Accepted: 29 Oct 2022

Published: 04 Nov 2022

J Short Name: COS

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Citation:

Jian Li. Surgical Treatment for Acute Lung Abscess Secondary to Lung Cancer: A Case Report. Clin Surg. 2022; 8(5): 1-5

Keywords:

Lung cancer; Lung abscess; Surgery

1. Abstract

Secondary lung abscess is the abscess formed by co-infection on top of the primary lung diseases. The formation of the lung abscess will make the treatment of the primary lung diseases difficult, especially if it is secondary to lung cancer. The therapy of lung cancer is a comprehensive treatment based on surgery. But the inflammatory environment, tissue adhesion, and risk of pus cavity rupture brought by lung abscess can increase the difficulty and risk of surgery. Here, we report a case of acute lung abscess secondary to lung cancer, which was discharged after surgical treatment.

2. Introduction

Lung abscess is the necrotic lesion of lung parenchyma caused by microorganisms and then forming a pus cavity containing necrotic material or liquefied necrotic material which often presents as a liquid-gas plane [1, 2]. High fever, cough, and large amounts of thick sputum are the characteristic clinical performance. According to the route of infection, Lung abscesses can be divided into the following categories: (1) aspiration lung abscess, (2) secondary lung abscess, and (3) hematogenous lung abscess [3]. Secondary lung abscess is mostly secondary to other diseases, and distal purulent infection caused by obstruction of bronchi by lung tumors is one of the common causes. But the course to form lung abscesses is relatively long. With the improvement of detection technology and universal access to medical examination, patients with lung tumors can often be diagnosed and treated at an earlier stage. The cases that progress to abscess formation have become less common in clinical practice. Here, we report a patient with surgical treatment of lung abscess secondary to lung cancer.

3. Case Presentation

On May 2, 2022, a 64-year-old male was admitted to the local state hospital with intermittent hemoptysis, and a chest CT scan revealed a space-occupying lesion (2.8*3.2cm) (Figure 1) in his right inferior lung with slightly dilated and infected in the distal bronchi. The lesion was preliminarily considered lung cancer. Further improved bronchoscopy showed a neoplasm in his dorsal segment of the right inferior lung, but the transbronchial biopsies (TBB), bronchial brushing, and bronchoalveolar lavage (BAL) did not suggest malignant signs. So, the patient consulted our hospital for a clear diagnosis and better treatment on May 8, 2022. He used to undergo a cholecystectomy without a history of diabetes, joint pain, heart valvular disease, or surgery. He had 40 years' history of smoking, about 15 cigarettes a day, but no family history of the tumor. Once admitted, the patient underwent re-examination by CT that revealed patchy foci in the right inferior lung with cavity formation (Figure 2), suspected lung cancer, infectious lesions and abscess formation cannot be excluded. Moreover, laboratory inspection included: WBC $16.64 \times 10^9/L$, NEU# $13.07 \times 10^9/L$, NEU%78.4%, ALB41.6 g/L, FEV1 2.93L, FEV1% 106.7%, FEV1/FVC 79.1%, PEF 5.15L/S, and repeat bronchoscopy also failed to find definitive evidence of tumor diagnosis (Figure 3). Two days after admission, the patient suffered from sudden pain in the right chest and persistent high fever with a maximum temperature of 39.4°C. After anti-infective treatment with piperacillin, the temperature did not decrease significantly and the inflammatory indexes increased. Re-examination of CT showed the cavity enlarged compared to previous, and new multiple foci of infection in the right lung with partial solidity in the middle and lower lobes

(Figure 4). And then Meropenem was given after a multidisciplinary consultation on May 12, 2022. After 3 days of anti-infection treatment, the patient’s temperature and infection indicators gradually decreased. And a repeat chest CT on May 18 showed that the patient’s abscess cavity was significantly smaller than before (Figure 5). Subsequently, we scheduled his surgery on May 20, 2022. Intraoperatively, we saw extensive mesh-like adhesions in the thoracic cavity with “closed chest” changes and extensive thickening of the mural pleura with fibrous plate-like changes. Abscess formation was seen in the right lower lung, and the abscess ruptured and pus flowed out during intraoperative exploration. The lumpectomy was performed because of multiple hard calcified lymph nodes embedded between the right pulmonary artery trunk and bronchus,

which were difficult to free respectively. The intraoperative frozen retrieval showed: squamous cell carcinoma of the lung. Combined with postoperative histological and immunohistochemical findings which showed CK (+), EMA (+), Vim (-), CK7 (-), P63 (+), P40 (+), CK5/6 (+), CK20 (-), TTF-1 (-), NapsinA (-), CD56 (-), Syn (-), CgA (-), Ki-67 (80%+), the diagnosis was moderately differentiated squamous cell carcinoma of the right lower lung (Figure 6). The patient’s symptoms resolved rapidly after the operation, and the temperature and infection indicators dropped too normal. He was discharged on June 4, 2022, with no complications other than fat liquefaction in the surgical incision. The patient returned to the hospital one month after discharge for a follow-up chest CT that showed excellent recovery (Figure 7).

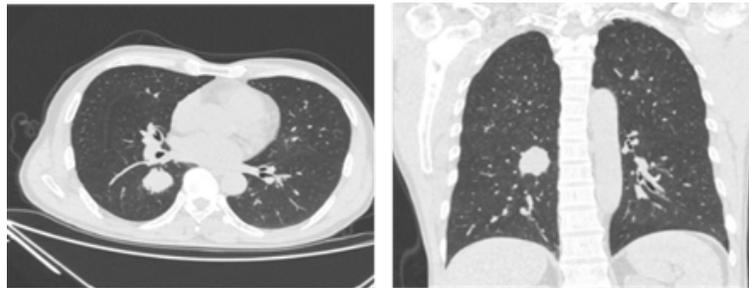


Figure 1: Chest CT of the external hospital (2022-05-02). A lobulated soft tissue density nodule was seen in the dorsal segment of the right lower lobe, measuring approximately 2.8 cm x 3.2 cm, with uniform density and relatively smooth margins, and slightly dilated bronchi distal to the nodule.

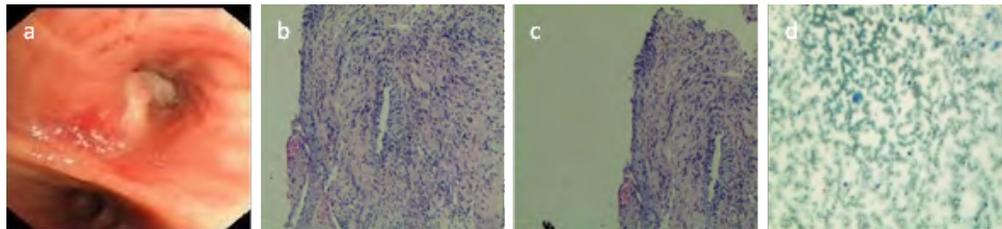


Figure 2: Bronchoscopy (a: new organism in the dorsal segment of the right lower lobe; b, c: Biopsy section; d: Brushing)



Figure 3: Chest CT (2022-05-08): Patchy foci with cavity formation in the lower lobe of the right lung.

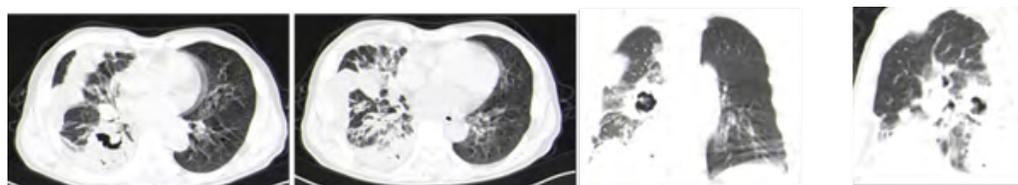


Figure 4: Chest CT (2022-05-13): Patchy foci with cavity formation in the lower lobe of the right lung (the extent is larger than before, now about 4.9×5.9 cm, the cavity shadow is also larger than before and liquid-air plane is seen, and there are new multiple vacuole shadow). New multiright lung with partial solidity in the middle and lower lobes.

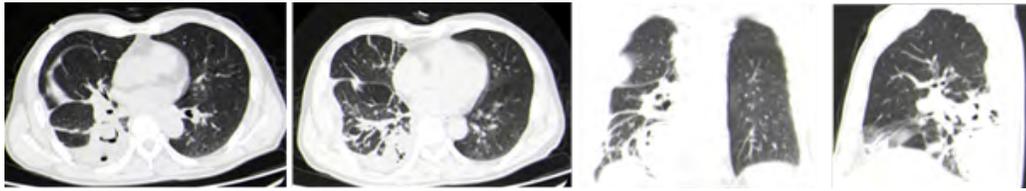


Figure 5: Chest CT (2022-05-18): A patchy hyperdense shadow with cavity formation in the lower lobe of the right lung was reduced in extent, and multiple foci of infection in the right lung with some solid lesions in the middle and lower lobes were reduced from before.

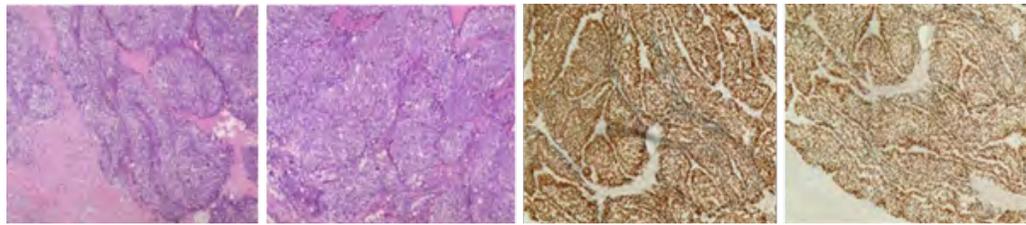


Figure 6: Pathology: CK (+), EMA (+), Vim (-), CK7 (-), P63 (+), P40 (+), CK5/6 (+), CK20 (-), TTF-1 (-), Napsin A (-), CD56 (-), Syn (-), CgA (-), Ki-67 (80%+). Histological morphology combined with immunohistochemical findings led to the diagnosis of (right lower lung lesion) squamous cell carcinoma (moderately differentiated).

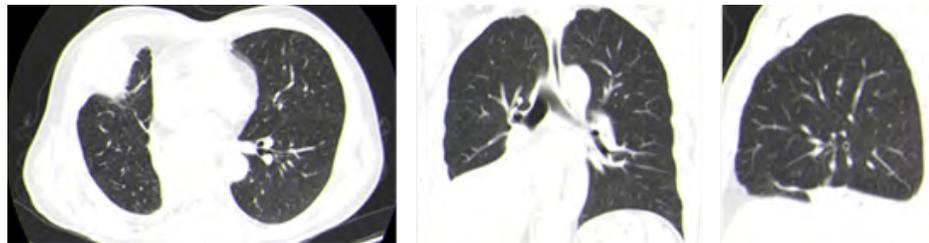


Figure 7: Chest CT (2022-07-11): Bronchial truncation in the lower lobe of the right lung after right lower lung Ca.

4. Comments

As medicine has evolved, the treatment of lung abscesses has undergone a major shift [2, 4-6]. During the period of non-specific treatment, the mortality rate of lung abscesses was extremely high, up to 75% [7]. As anesthesia techniques matured, Lilienthal performed the first anatomic resection for lung abscess in 1914. Subsequently, his student Neuhof improved open drainage surgery, and the mortality rate of lung abscesses decreased significantly. In his report, the overall mortality rate is only 2.47% in 162 patients treated with his phase I open drainage procedure at Mount Sinai Hospital from 1925-19438. In the 1940s antibiotics advent, the use of penicillin not only overturned the surgical treatment of lung abscesses but also led to a significant decrease in the incidence of lung abscesses [6].

Cancerous abscesses and benign lung abscesses have similar clinical symptoms and imaging features, making it difficult to distinguish them until a definitive pathologic diagnosis is acquired. However, benign lung abscesses and lung abscesses secondary to lung cancer have different treatment approaches, strategies, and predicted outcomes [9, 10]. Benign lung abscesses generally resolve with antibiotic therapy and rarely require surgical intervention [11]. In contrast, lung abscesses secondary to lung cancer require early surgical treatment. Early surgical management of lung cancer secondary to lung abscess can result in a better outcome, preferably before the onset of pulmonary sepsis or infectious

shock, but the prognosis is generally poor. Local conditions, host resistance, and infection factors all play a role in the formation of lung abscesses, with immune competence being an important factor. It is generally accepted that increased tumor-induced immunosuppressive signals and impaired immune function may exacerbate bacterial infections when a tumor is present [12]. And the tissue lysis and drainage due to lung abscess can lead to tumor metastasis. In 36 cases of lung cancer misdiagnosed as lung abscess reported by Ren Shangao et al. in 2001 [13, 14], the misdiagnosis lasted from 75 to 180 days, an average of 108 days. Finally, 33 patients underwent surgery, and the postoperative lymph node metastasis rate was as high as 88.4% (114/129). All 33 operated patients had pulmonary hilar lymph node metastasis (100%).

Up to now, the timing and indications for surgery related to lung abscesses have not been well established. Surgical managements and outcomes are complicated by numerous factors [10, 15]. Surgery is often as an option after the failure of conservative treatment. But the timing of surgery is often much more delayed than expected even though the patients had a definite diagnosis of lung cancer because the coexistence of tumor progression and lung infection prevents a trade-off between infection and antitumor therapy in the treatment strategy [16, 17]. However, most reports suggest that once an abscess has formed within the tumor, conservative treatment with antibiotics may be difficult to control the infection [18]. The inflammatory environment of the body, tissue adhesions, and

risk of pus cavity rupture associated with lung abscess would increase the difficulty and risk of surgery. In Yamanashi's research [19], surgical treatment of lung cancer combined with lung abscess was often related to more blood loss and longer operative time, and the stage of overall tumor was higher than stage II. Even so, surgery is still feasible. In this case, lung cancer was initially suspected when the patient presented to the local hospital with intermittent hemoptysis, and an examination revealed an occupying lesion in the lung. Although bronchoscopy did not reveal cancerous cells, a new organism was seen in the dorsal segment of the bronchus. After admission, it became difficult to distinguish benign lung abscess from infectious lesion because of the progression of the disease, abscess formation, and aggravation of the lesion after broad-spectrum antibiotic treatment. Combined with the patient's age, previous physical condition, and lack of history of misuse and smoking, the Possibility of lung cancer was considered high, and postoperative pathology confirmed our diagnosis.

Aggressive control of the patient's temperature and infection indicators, reduction of sputum excretion, and improvement of the patient's general condition to perform the procedure in the best possible conditions remain emphasized in pre-surgery. Patients with low fever can undergo surgery after 3-5 days of antibiotic therapy. For patients with high fever, surgery should be performed promptly after 5-7 days with broad-spectrum antibiotics or sensitive antibiotics based on pus culture, preferably to control the temperature below 38°C. However, urgent surgical resection is considered the most effective treatment strategy when the infection is difficult to control and the disease increasingly worsens, even if the patient is at the peak of inflammation [16]. The optimal timing of surgery should be evaluated based on the patient's general status, the condition of the lesion, and his own psychological and economic conditions. Surgical treatment can both remove the infected foci and provide a further diagnosis, which can generally result in a satisfactory prognosis and better long-term survival. The postoperative morbidity and mortality rates of 11 patients with lung cancer combined with lung abscess from 2007-2015 at Kurashiki Central Hospital in Japan were 63.6% and 0.0%, respectively, and the 5-year overall survival rate was 43.3% [19]. The preferred surgical approach is lobectomy or segmental resection [11]. Video-assisted thoracoscopic surgery (VATS) has made great progress. It's safe and feasible in patients with infectious lung disease [20], but tissue adhesions, stiff lymph nodes, and limited visualization make its use in giant lung cancers or lung cancer co-infection still challenging [18]. In this case, the patient had to accept a thoracotomy due to tight intraoperative adhesions and lymph node impaction. But he recovered well after surgery with no complications other than fat liquefaction in the wound.

Bronchoscopy is considered to be the main reason for the development of cancerous lung abscesses. Ishida [21], Shimoda [22] et al. reported several cases of intratumoral lung abscess after bronchos-

copy. However, bronchoscopy is not only helpful for diagnosis but may be an effective treatment to relieve airway obstruction and drainage [13, 23]. Preoperative bronchoscopy and sputum cytology are necessary for use in definitive diagnosis.

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