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Case Report

A large primary lung abscess due to *Klebsiella oxytoca*: How critical the combination between early antibiotic therapy and bronchoscopy?

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Abstract

Lung abscess is a microbial infection that can cause necrosis of the lung tissue and formation of cavities. Antibiotics and bronchoscopy are needed in the management of large lung abscess to prevent further complications. However, some of the cases have poor clinical improvement. The aim of this case report was to describe a patient with large lung abscess who had well responded to antibiotic therapy combined with bronchoscopy drainage. We reported a 55-year-old man with a lung abscess presented with initial symptom of acute productive cough for two weeks. Chest computed tomography (CT) scan with contrast of patient indicated a massive abscess on the right lung segment with a size of 10.9 x 10.41 x 8 cm. Laboratory examination showed leukocytosis. Bronchoscopy was performed as a diagnostic and therapeutic procedure. Antibiotic resistance test was conducted from bronchoalveolar lavage sample to determine the most suitable antibiotics for the patient. The culture yielded a positive for *Klebsiella oxytoca* that was resistant to ampicillin and cefazolin. The bacterium was sensitive to piperacillin-tazobactam, aztreonam, ceftazidime, ceftriaxone, ertapenem, cefepime, nitrofurantoin, meropenem, amikacin, gentamicin, ciprofloxacin, tigecycline, trimethoprim- sulfamethoxazole, and levofloxacin. Levofloxacin 750 mg injection was given for 14 days followed with oral levofloxacin 500 mg once a day for four weeks and bronchoscopy to stop the microbial infection process in the lung tissues. Lung abscess reduced significantly and the patient was followed until recovered. In conclusion, early combination therapy of adequate antibiotics and bronchoscopy is effective in treating a massive lung abscess caused by *Klebsiella oxytoca*.

Keywords: Lung abscess, antibiotic therapy, bronchoscopy, Klebsiella, *K. oxytoca*

Introduction

Lung abscess is a type of lung infection defined as an area of purulent exudate in lung parenchyma [1]. This will lead to the formation of cavity and after bronchopulmonary fistula is formed, an air-fluid level will appear [2]. Lung abscess can be classified as primary (due to direct infection to the lung parenchyma in healthy patients) and secondary from the predisposing factors, such as septic embolization, bronchial obstruction, or immunocompromised conditions [3].

Lung abscess is caused by mixed population of bacteria, different from most respiratory infections that are caused by single agent. The most typical bacterial population in lung abscess

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is anaerobic bacteria, particularly Peptostreptococcus species [1,4,5]. Lung abscess may also be caused by pyogenic bacteria, mycobacteria, fungi and parasites [6,7].

Antibiotic therapy is currently the main treatment for lung abscess. However, in the case of massive abscess, drainage can also be performed to support patient's recovery, and bronchoscopy could be one of the techniques. This case report describes a case of a patient with large lung abscess that well responded to antibiotic treatment combined with bronchoscopy drainage.

Case

On early December 2022, a 55-year-old male patient came to the pulmonary clinic of Sebelas Maret University Surakarta with the chief complaint of coughing for the last two weeks. The patient complained of having a cough with white-yellowish and foul-smelling phlegm. The cough occurred continuously, both during activities and at rest. The cough became worse with smoking, and did not subside with coughing medicines. The patient also complained of losing 6 kg since experiencing the symptoms. Other complaints such as fever, runny nose, painful swallowing, chest pain or shortness of breath were denied. The patient had never experienced this problem. The patient denied any histories of hypertension, diabetes, or allergies. The family, who lived in the same house, had a history of pulmonary tuberculosis before the patient experienced the symptom. The patient worked as a farmer and had been smoking for around 30 years.

On physical examination, the blood pressure was 120/80 mmHg, pulse 88 beats per minute (bpm), respiratory rate 20x/minute, SpO_2 97%, and the body mass index (BMI) was 13.5 kg/m^2. Thoracic examination showed decreased tactile fremitus, dull sound on percussion, and coarse wet rhonchi in the superior part of the right lung. No murmurs or abnormal heart sound were detected. All four extremities were warm and not edematous. Blood laboratory examination showed an increased leukocyte count (20.83x10^3/mm^3) and 81.5% of absolute neutrophils count. A molecular test with G4 Xpert MTB-RIF assay of the patient's sputum came out negative for tuberculosis. Chest X-ray showed a relatively homogeneous opacity with consolidation in the supra-hilar of the right lung, suggesting a lung mass (**Figure 1**). The patient then had a thorax computed tomography (CT) scan with contrast. The results of the thorax CT scan with contrast suggested an abscess with a size 10.9 x 10.41 x 8 cm on the right lung segment (**Figure 2**).

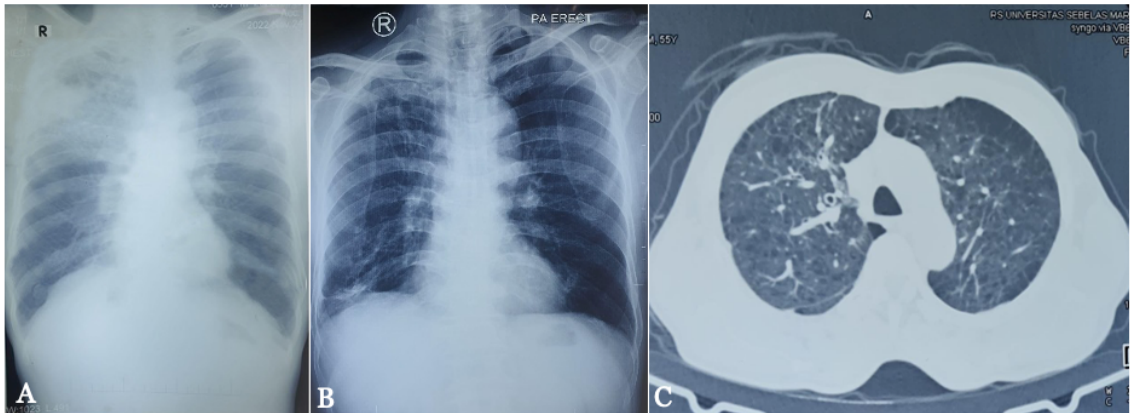

Figure 1. Chest X-ray and computed tomography (CT) scan of the patient. (A) Chest X-ray of patient on December 2022 suggesting a lung mass. Chest X-ray (B) and CT scan (C) evaluations of patient on February 2023 after treatment.

The patient then underwent bronchoscopy for bronchoalveolar lavage (BAL). Cytology of bronchoalveolar lavage results showed suppurative inflammation with squamous cell metaplasia of the bronchus. The culture and antibiotic sensitivity test were also performed on BAL sample obtained from bronchoscopy and returned with the growth of *Klebsiella oxytoca* that was resistant to ampicillin and cefazolin. *K. oxytoca* was sensitive to piperacillin-tazobactam, aztreonam, ceftazidime, ceftriaxone, ertapenem, cefepime, nitrofurantoin, meropenem, amikacin, gentamicin, ciprofloxacin, tigecycline, trimethoprim-sulfamethoxazole, and levofloxacin. The antibiotic sensitivity recommended for levofloxacin to be administered to the patient.

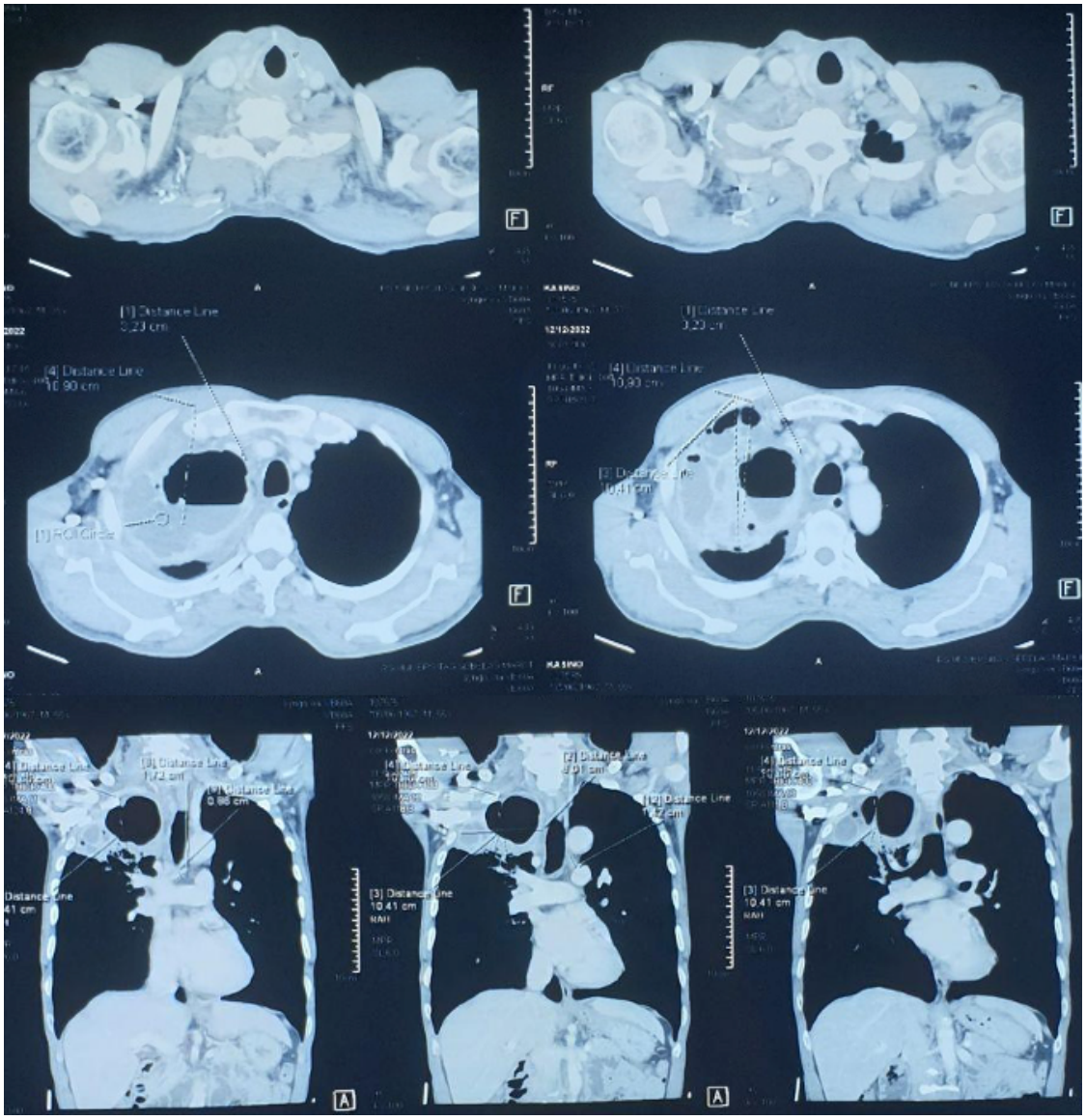

Figure 2. Chest computed tomography (CT) scan with contrast of patient on December 2022 indicating a massive abscess with a size 10.9 x 10.41 x 8 cm on the right lung segment.

The patient was given levofloxacin 750 mg injection for 14 days followed with oral levofloxacin 500 mg once a day for four weeks. The patient also administered N-acetylcysteine injection 1,200 mg once daily for 14 days, followed with oral N-acetylcysteine 200 mg three times a day. The patient was discharged from hospital after 14 days after admission. Therapy of N-acetylcysteine was continued until a total of two months of treatment.

On February 2023, seven days after the discharge, the patient returned to the pulmonary outpatient clinic and reported that the cough had markedly reduced. The patient then underwent a chest X-ray and CT scan for an evaluation of the therapy. The chest X-ray showed significantly reduced suprahilar opacity on the right lung and showed no increase in broncho-vascular markings. The CT scan results also showed a significant improvement after the therapy (**Figure 1**).

Discussion

Lung abscess is described as a circumscribed area of pus or necrotic debris in the lung parenchyma that leads to a cavity, and after bronchopulmonary fistula formation, an air fluid level formed inside the cavity [2]. Lung abscesses are more frequently observed in male patients over the age of 50 with predisposing factors such as dental, periodontal infection, coexisting lung diseases, pneumonia, diabetes mellitus, and immunosuppression state.[3] Based on the etiology,

it is classified as primary and secondary lung abscess. Primary lung abscess is the result of aspiration of oropharyngeal secretions (dental/periodontal infection, para nasal sinusitis, altered states of consciousness, swelling disorders, gastro-esophageal reflux disease, frequent vomiting), necrotizing pneumonia, or in immunocompromised individuals [8]. Meanwhile, secondary lung abscesses developed in bronchial obstructions (due to tumors, foreign bodies, or enlarged lymph nodes), with concurrent lung disorders, then spreading from extrapulmonary sites-hematogenous or by direct spreading [8]. Lung abscesses can spread through bronchogenic (aspiration, inhalation) or hemogenic (dissemination from other infected sites) methods [8]. Lung abscess is considered primary in this case because it resulted directly from infection of the lung parenchyma in the absence of predisposing lung issues. There is a possibility that smoking could have contribution as risk factor causing lung abscess in this case.

This patient has been smoking for 30 years, even after started experiencing the symptoms. Smoking is a risk factor for lung abscess. Smoking may not directly cause lung abscess, but it may damage immune defenses against lung infection [9]. Smoking increases the recurrence rate and uncured rate of infection [10]. The airway epithelium is the first defense structure to be affected by pollutants and pathogens. Cigarette smoke can directly damage the airway epithelial barrier, including cilia, goblet cells, basal cells, and submucosal secretory glands [11]. Exposure to chemical substances as found in cigarettes, such as nicotine, can affect ciliary function, which can cause mucus hypersecretion and reduced mucociliary clearance. These conditions make it easier for pathogens to colonize and reproduce [12]. A previous study conducted in 2018 found that 17% of lung abscess patients in tertiary health facilities in India were smokers [13]. Quitting smoking could increase the success of the therapy in patients with lung abscess such in this case [14].

Lung abscess can be asymptomatic or symptomatic, but most frequently, patients report of having fever and chills (80% of cases), a productive cough (55–90% of cases), chest pain (20–35% of cases), and hemoptysis (10% of cases) [15]. Coughing is non-productive at first, but when the infection reaches the bronchus, a productive cough is the common sign. Coughing continues to be productive, sometimes accompanied by hemoptysis. Clubbing fingers could appear in patients with chronic abscesses [8]. In our case, initially, the patient in this report had acute symptoms of productive coughing for two weeks prior to admission to the hospital - where the patient experienced continuous coughing with white-yellowish purulent sputum. Other complaints included weight loss. The patient denied of coughing up blood. This is in line with the theory that the signs and symptoms of a lung abscess are similar to those of pneumonia, thus a supporting examination is required to make a diagnosis.

Imaging is typically used to establish the diagnosis, which was then confirmed by the symptoms [6]. The imaging method that is frequently used is chest X-ray, however, the use of CT scan could help picturizing and identifying the abscess better. An area of cavitation surrounded by consolidation will be seen in such lesions. An area with necrosis in the acute process will have an irregular shape and a thick wall [16]. The walls will become thin and homogeneous as the abscess resolves as it progresses towards to the chronic phase [7]. The patient's chest X-ray indicated a relatively homogenous opacity with consolidation on the suprahilar part of the right lung, while the CT scan with contrast revealed an abscess of 10.9 x 10.41 x 8 cm in size on the right lung. A diagnosis of lung abscess was confirmed after G4 Xpert MTB-RIF assay that yielded negative result for tuberculosis.

Antibiotics are the cornerstone of lung abscess treatment, and antimicrobial therapy is effective in about 95% of patients with lung abscess [17]. Intravenous clindamycin 600 mg every 8 hours is the standard conservative treatment for a lung abscess caused by anaerobic bacteria, and it has been shown in multiple clinical trials to be superior to penicillin in terms of response rates, length of fever, and time to resolution of putrid sputum [18,19]. The results of resistance and sensitivity test indicated that the causative bacteria had ampicillin resistance. Therefore, the patient was treated with levofloxacin, according to the recommendation of the sensitivity test. Antibiotic treatment may work after three to four days of therapy. General condition will start to improve and after seven to ten days it will get better completely. However, it will take two months for the radiographic results to return to normal. The length of antibiotic therapy is determined by the patient's clinical and radiological response. Antibiotic therapy should remain at least until fever, foul sputum, and abscess fluid have resolved, which generally takes 5–21 days for

intravenous antibiotics and 28–48 days for oral antibiotics with frequent radiographic and laboratory controls [8].

As previously mentioned, the patient had a large lung abscess (more than 6 cm) and conservative therapy with antibiotic only was considerate not adequate. Lung abscess drainage should be considered, with the option of installing a chest tube or surgical resection of the lung abscess and the surrounding tissue. In this patient, alternative drainage was performed using bronchoscopy which could be useful as a treatment as well as a diagnostic modality in this case. Bronchoscopy is a key diagnostic technique to view the airways and obtain sample to guide better treatment. The aim of BAL in this case was to remove the excess mucus and dilute the remain mucus and therefore it was easier for the patient to cough up. It is necessary to perform BAL due to large diameter of lung abscess or if there is no improvement of general condition or imaging findings after empiric antibiotic therapy [8,20].

There are some limitations of this case report that need to be discussed. Lung function tests such as spirometry and diffusing capacity for carbon monoxide (DLCO) were not performed for pre- and post-therapy because patient could not perform the maneuver. The success of levofloxacin therapy cannot be generalized in all lung abscess cases because it depends on the type of organisms and the antibiotic sensitivity pattern of each hospital.

Conclusion

We reported a case of a 55-year-old man with an initial symptom of acute productive cough for two weeks. Laboratory examination showed leukocytosis and radiological examinations suggested a possible lung abscess. A combination of antibiotic therapy and BAL was chosen to inhibit the microbial infection process in the lung tissue. The abscess was reduced significantly after two months evaluation indicated by clinical and imaging improvements. This case highlights that for a massive lung abscess, early combination therapy of adequate antibiotic and BAL is important to provide favorable outcome.

Ethics approval

Not required. The patient provided written informed consent to be published as case report.

Competing interests

The authors declare that there is no conflict of interest.

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Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

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