



# Lung Abscess: Diagnosis and Treatment

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## ABSTRACT

Lung abscess is a microbial infection of the lungs that results in pulmonary parenchyma necrosis. Meticulous history taking, physical examination, and prompt diagnostic workup are necessary for establishing the diagnosis. Antibiotics are the cornerstone for lung abscess' treatment with size less than 6 cm.

**Keywords:** Antibiotic, lung abscess, microbial infection

## ABSTRAK

Abses paru adalah infeksi mikroba pada paru yang menyebabkan nekrosis parenkim paru. Anamnesis dan pemeriksaan fisik yang teliti, serta pemeriksaan penunjang yang tepat penting untuk diagnosis. Antibiotik merupakan pilihan terapi utama untuk abses paru berukuran kurang dari 6 cm. **Sherly Lawrensia. Abses Paru: Diagnosis dan Tatalaksana.**

**Kata kunci:** Abses paru, antibiotik, infeksi mikroba

## Introduction

Lung abscess is a microbial infection of the lung that results in pulmonary parenchyma necrosis.<sup>1</sup> Liquefactive necrosis of the lung parenchyma then forms cavities.<sup>2</sup> Lung abscesses can be single or multiple; usually are marked by a single dominant cavity with more than 2 cm in diameter.<sup>3</sup> More virulent infection may result in multiple small lung abscesses, defined as necrotizing pneumonia or lung gangrene.<sup>1</sup> Although lung abscess' incidence has been decreasing in this antibiotic era, it still becomes a significant source of morbidity and mortality.<sup>1,3</sup>

## Classification

Based on the duration of illness, lung abscess can be classified as:<sup>1,2,4</sup>

- Acute: less than 6 weeks.
- Chronic: more than 6 weeks.

Based on the progression, lung abscess can be classified as:<sup>3-5</sup>

- Primary: lung abscess in the absence of underlying pulmonary lesions. It can be

caused by aspiration of oropharyngeal secretions.

- Secondary: lung abscess in the presence of underlying pulmonary lesions such as bronchiectasis, bullous emphysema, or cystic fibrosis.

Based on the mode of spreading, lung abscess can occur via:<sup>2</sup>

- Bronchogenic: occur by aspiration or inhalation of oropharyngeal secretions
- Haematogenic: dissemination from another infected site, such as abdominal sepsis, infective endocarditis, septic thromboembolism.

## Etiology

In the pre-antibiotic era, lung abscess was caused by one type of bacteria, and today almost all cases are caused by polymicrobial flora.<sup>6</sup> More than 90% cases of lung abscess are caused by anaerobic bacteria, streptococcus is the second most common cause.<sup>7</sup> Primary lung abscess is usually formed by aspiration of anaerobic

bacteria.<sup>3</sup> Anaerobic bacteria, bacteria that exist in the mouth as normal flora in gingival cervices, is considered as the most likely etiologic agent of nonspecific lung abscess.<sup>1,5</sup> This nonspecific lung abscess consists of Gram-negative bacteria (i.e. *Bacteroides fragilis*, *Fusobacterium capsulatum*) or Gram-positive bacteria (i.e. *Pepto-streptococcus* and *microaerophilic streptococcus*).<sup>2</sup> Anaerobic bacteria and *Microaerophilic streptococcus* are the major etiologic agents of lung abscess in the immunocompetent host.<sup>8</sup>

Aerobic bacteria that cause lung abscess are *Staphylococcus aureus* (including methicillin-resistant staphylococcus aureus [MRSA]), *Streptococcus pyogenes* and pneumonia, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, type B *Haemophilus influenzae*, *Escherichia coli*, and *Legionella*.<sup>1,7</sup> Hirshberg, et al, demonstrated that patients with lung abscess had a worse prognosis if *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* or *Staphylococcus aureus* were identified.<sup>9</sup> *Mycobacterium tuberculosis*,



fungi, and parasites can also be an important cause of pulmonary infections and abscess.<sup>1</sup>

### Risk Factors

The major risk factor for a primary lung abscess is aspiration. Patients that have a higher risk for aspiration are those with altered mental status, overdose or drug abuse, alcoholism, seizures, neuromuscular disorders with bulbar dysfunction, dental infections, corticosteroids therapy, and immunocompromised status.<sup>3,5,10</sup> Patients with esophageal dysmotility, stricture or tumor of esophagus, and those with gastric distention and/or gastroesophageal reflux, especially those who spend substantial time in the recumbent position, are also at risk for aspiration.<sup>3</sup>

### Signs and Symptoms

Clinical symptoms of lung abscess are fever, productive cough (with sputum production), and malaise or fatigue.<sup>1</sup> These symptoms can occur over days to weeks, mostly within two weeks.<sup>1,4</sup> The patient seems like having a persistent pneumonia.<sup>4</sup> If the infection is chronic, the symptom may include weight loss and other constitutional symptoms.<sup>5</sup> Patients may have putrid-smelling sputum which indicates an anaerobic bacteria infection. If the infection is spreading to pleura via direct spreading or bronchopleural fistula, the patient will have pleurisy or experience pleuritic chest pain.<sup>1</sup> Erosion to the bronchial vessels will result in hemoptysis.

### Approach to the Patient

#### 1. History

In all suspected cases of lung abscess, a complete and systematic history must be taken. The history should include and focus on the onset, chronology of the disease, risk factors, predisposition factors, comorbid conditions, and recent pulmonary infection.<sup>4</sup> Patient's symptoms such as fever, productive cough (putrid sputum with foul-smelling breath), or malaise may suggest lung abscess as one of the differential diagnosis.<sup>3</sup>

#### 2. Physical Examination

Complete general and specific physical examination should be done. Physical examination must focus on vital signs and pulmonary examination. The vital signs may show a rise in body temperature (fever) and an increase in respiratory rate (tachypnea). Pulmonary examination will result in dullness

to percussion, increased fremitus, inspiratory crackles, and bronchovesicular sounds on auscultation. Patients with chronic lung abscess will show clubbing finger.<sup>4</sup>

### 3. Laboratory Studies

A complete blood count may result in leucocytosis and anemia of chronic disease.<sup>4,5</sup> Blood culture may be ordered if the patient is suspected to have a secondary lung abscess.<sup>4</sup> Sputum gram stains show many neutrophils and mixed flora, with many morphologically different bacteria, and normal respiratory flora.

Patients without the classic presentation and patients with secondary lung abscess should have stains and cultures of expectorated sputum for aerobic bacteria, mycobacteria, fungi, and parasites because the expectorated sputum is contaminated by oral flora containing large numbers of anaerobes.<sup>5</sup> Bronchoalveolar lavage (BAL) cultures and routine sputum cultures are more likely to yield aerobic organisms. Anaerobic bacteria are difficult to isolate and are extremely sensitive to antibiotics, which may have been administered before collection. In typical cases of lung abscess, BAL/sputum cultures are not routinely recommended to detect anaerobic pathogens due to their frequent contamination from normal flora of the oral cavity.<sup>4,11</sup> Sputum cultures have been proven to be useful in identifying lung abscess attributed to aerobic microorganisms such as *Klebsiella spp.*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*.<sup>11</sup>

### 4. Radiologic Studies

Common imaging modalities that can be used to diagnose lung abscess are plain film chest x-ray (CXR) and chest computed tomography (CT). A chest x-ray will show solitary or multiple cavities with irregular thick walls within the lung parenchyma localized to one pulmonary segment or lobe.<sup>4,5</sup> Communication of such cavities with the bronchial tree results in a cough productive of purulent sputum and the presence of air fluid levels on chest x-ray. Primary lung abscess from aspiration may be located at the posterior segments of the upper lobes and the superior segments of the lower lobes.<sup>4</sup> The involvement of multiple lobes may suggest an immunocompromised condition or hematogenous spread of infection.<sup>3,5</sup> Computed tomography (CT) is more sensitive than CXR and is useful to detect small

cavities, provide evidence of obstructed endobronchial lesions, and distinguish lung abscesses from air-fluid levels in the pleural space or empyema.<sup>4,5</sup>

### Treatment

The management of lung abscess can be divided into two categories; pharmacologic and non-pharmacological therapy.

#### 1. Pharmacologic Therapy: Antibiotic

Antibiotics are the cornerstone for lung abscess' treatment and almost 95% patients respond to antimicrobial therapy.<sup>11</sup> For many years, penicillin was the antibiotic of choice for primary lung abscess. However, because oral anaerobes can produce  $\beta$ -lactamases, penicillin doesn't offer adequate coverage; and clindamycin has been proven superior to penicillin in clinical trials.<sup>3,4</sup>

The recommended regimens for primary lung abscesses are:

1. Clindamycin (600 mg IV three times daily; then, with faster resolution of fever and better clinical improvement can be followed by 300 mg PO four times daily).<sup>1,3,4</sup>
2. Beta-lactam/beta-lactamase inhibitor, potentially in combination with an antibiotic with methicillin-resistant *Staphylococcus aureus* (MRSA) coverage (i.e., vancomycin). If the patient's condition is stable, can be followed by oral amoxicillin-clavulanate.
  - Ampicillin-sulbactam 3 g IV q6-8 has shown similar efficacy to clindamycin (with or without cephalosporin) for significant aspiration events leading to bacterial infection and/or lung abscesses.<sup>4</sup>
  - Some data support the use of fluoroquinolone antibiotic (e.g., moxifloxacin or levofloxacin) with anaerobic bacteria coverage due to similar cure rates reported with moxifloxacin 400 mg PO daily. Moxifloxacin appears to be clinically as effective and as safe as ampicillin-sulbactam.<sup>12</sup>
  - Carbapenem includes ertapenem 1 g IV q24, imipenem-cilastatin 500-1000 mg IV q6, or meropenem 1 g IV q8.<sup>4</sup>

Metronidazole should *not* be used as a



monotherapy. It is not effective as a single agent because it covers anaerobic organisms but not the microaerophilic streptococci that are often also components of the mixed flora of primary lung abscesses.<sup>3</sup> This agent may be used in selected cases in conjunction with a beta-lactam antibiotic such as ceftriaxone. The standard dose is metronidazole 500 mg IV/PO q6–8.<sup>4</sup>

Therapy should be continued until imaging shows regressed or cleared lung abscess to a smaller scar. The duration of treatment may range from 3 – 4 weeks to as long as 14 – 16 weeks.<sup>3,4</sup> Clinical improvement is shown by subsidence of fever in the first 3–4 days and complete resolution within 7–10 days.<sup>4</sup> Age and abscess size are positively correlated with a longer time to radiologic resolution or improvement.<sup>13</sup> Persistent fever can be explained by treatment failure due to uncommon pathogens (e.g., multi-drug-resistant bacteria, mycobacteria, fungi) or by the presence of an alternative diagnosis.<sup>4</sup> Treatment regimens for secondary lung abscess should be directed at the identified pathogen. The course of the disease itself is often depending on the immunity of the host.

Other interventions such as relief of an obstructing lesion may be necessary. Some additional studies may be needed to rule out any predisposing factors that make the presumed lung abscess fail to improve.<sup>3</sup>

Most lung abscesses can drain themselves through communication with large airways (tracheobronchial tree); if the patient is clinically improving with adequate sputum production, no surgical management should be required.

### 2. Drainage and Indication of Surgery

Lung abscess with more than 6 cm in diameter is less likely to respond or improve with only antibiotic therapy without additional interventions. They may require extended treatment courses and surgical or drainage.<sup>13</sup> Surgical intervention and drainage of the abscess are two treatments of choice for lung abscess that do not respond to antimicrobial treatment or in patients with impaired cough reflex.<sup>3,14</sup>

Drainage is indicated in the presence of air-fluid levels.<sup>5</sup> It can be done by percutaneous or endoscopic techniques. Percutaneous drainage is a minimally invasive method with high therapeutic effectiveness and preservation of functional lung tissue.<sup>15</sup> In some cases such as coagulation disorder, skin infection in thorax area, or when a large amount of lung tissue must be traversed, percutaneous drainage of lung abscess should be avoided, thus endoscopic technique can be the treatment of choice.<sup>15</sup>

Indication for lung resection (segmentectomy, lobectomy, or pneumonectomy) with or

without drainage are large cavities (> 6 cm), abscess caused by a resistant organism, an obstructing neoplasm, massive hemoptysis, associated bronchopleural fistula with or without empyema, and/or extensive necrosis.<sup>4</sup>

### Prognosis

The prognosis of patients with lung abscess is affected by the comorbidities and other predisposing factors. A retrospective study by Hirschberg, *et al*, among 75 patients with lung abscess showed that the mortality rate of patients with lung abscess are higher in patients with predisposing factors such as pneumonia, neoplasm, altered consciousness, and anemia. In addition, low immunity level including malnutrition and elderly patients are also a poor prognostic factor.<sup>14</sup> Lung abscess caused by *Pseudomonas aeruginosa*, *Staphylococcus aureus*, or *Klebsiella pneumoniae* is associated with worse prognosis.<sup>9</sup>

### Summary

Lung abscess is a lung infection caused by both anaerobic and aerobic bacteria. Although antibiotics are the cornerstone of the treatment, lung abscess can also lead to bad prognosis in patients with any comorbidities or low immunity levels. Additional workup examinations are needed to define which patients need the surgical or drainage therapy. Rational antibiotic use has to be emphasized in order to avoid unsuccessful treatment due to antibiotic resistance.

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