HARRISON'S PRINCIPLES OF INTERNAL MEDICINE — 22nd Edition

Lung Abscess

Chapter 132 | Part 5: Infectious Diseases | Part 5 – Infectious Diseases: Bacterial | DETAILED EDITION

KEY CLINICAL POINTS

1. Lung abscess is defined as necrosis and cavitation of the lung following microbial infection, typically a single dominant cavity >2 cm in diameter.
2. Primary lung abscesses (~80% of cases) arise from aspiration of oral flora (anaerobes) in susceptible hosts without underlying pulmonary/systemic conditions.
3. Secondary lung abscesses arise in the setting of underlying conditions (e.g., bronchial obstruction, immunosuppression) or septic emboli.
4. Risk factors for aspiration include altered mental status, alcoholism, bulbar dysfunction, seizures, and esophageal dysmotility.
5. Primary abscesses are polymicrobial, primarily including anaerobic organisms and microaerophilic streptococci; putrid sputum is virtually diagnostic of anaerobic infection.
6. Secondary abscesses often involve Pseudomonas aeruginosa, Staphylococcus aureus, or opportunistic fungi in immunocompromised hosts.
7. Diagnosis relies on chest imaging: CXR shows thick-walled cavity with air-fluid level; CT provides better definition and identifies underlying causes like malignancy.
8. Treatment of primary abscesses involves clindamycin or IV beta-lactam/beta-lactamase combination followed by oral amoxicillin-clavulanate.
9. Treatment duration ranges from 3–4 weeks to 14 weeks, with at least 6 weeks suggested for better outcomes.
10. Right lung is affected more commonly than the left due to the less angulated right mainstem bronchus.

FIGURES IN THIS CHAPTER

1. DEFINITION & OVERVIEW

• Lung abscess represents necrosis and cavitation of the lung following microbial infection.

• Lung abscesses can be single or multiple but usually are marked by a single dominant cavity >2 cm in diameter.

• Lung abscesses are characterized as either primary or secondary.

• Lung abscesses can also be characterized as acute (<4–6 weeks in duration) or chronic (~40% of cases).

• The availability of antibiotics in the 1940s and 1950s established therapy with this drug class as the primary approach to the treatment of lung abscess.

• Previously, surgery had been relied upon much more frequently; the incidence of lung abscesses has decreased significantly in the antibiotic era.

1.1 Classification

• Primary Lung Abscesses: Generally arise from aspiration, often caused principally by anaerobic bacteria, and occur in the absence of an underlying pulmonary or systemic condition.

• Secondary Lung Abscesses: Arise in the setting of an underlying condition, such as a postobstructive process (e.g., bronchial foreign body, tumor) or a systemic process (e.g., HIV infection, another immunocompromising condition).

• Acute vs Chronic: Acute is <4–6 weeks; Chronic is ~40% of cases.

2. EPIDEMIOLOGY

• The majority of existing epidemiologic information involves primary lung abscesses.

• In general, middle-aged men are more commonly affected than middle-aged women.

• The major risk factor for primary lung abscesses is aspiration.

• Patients at particular risk for aspiration include those with altered mental status, alcoholism, drug overdose, seizures, bulbar dysfunction, prior cerebrovascular or cardiovascular events, or neuromuscular disease.

• Additional risk factors include esophageal dysmotility or esophageal lesions (strictures or tumors) and those with gastric distention and/or gastroesophageal reflux, especially those who spend substantial time in the recumbent position.

• Colonization of the gingival crevices by anaerobic bacteria or microaerophilic streptococci (especially in patients with gingivitis and periodontal disease), combined with a risk of aspiration, is important in the development of lung abscesses.

• Many physicians consider it extremely rare for lung abscesses to develop in the absence of teeth as a nidus for bacterial colonization.

• The importance of these risk factors is highlighted by a significant reduction in abscess incidence in the late 1940s that coincided with a change in oral surgical technique (no longer performed with the patient in the seated position without a cuffed endotracheal tube).

2.1 Risk Factors

• Modifiable: Alcoholism, drug overdose, poor dentition, gastroesophageal reflux, recumbent position.

• Non-modifiable: Neuromuscular disease, prior cerebrovascular/cardiovascular events, esophageal lesions.

3. ETIOLOGY & PATHOPHYSIOLOGY

• The development of primary lung abscesses is thought to originate when chiefly anaerobic bacteria (as well as microaerophilic streptococci) in the gingival crevices are aspirated into the lung parenchyma in a susceptible host.

• Patients who develop primary lung abscesses usually carry an overwhelming burden of aspirated material or are unable to clear the bacterial load.

• Pneumonitis develops initially (exacerbated in part by tissue damage caused by gastric acid); then, over a period of 7–14 days, the bacteria produce parenchymal necrosis and cavitation whose extent depends on host–pathogen interaction.

• Anaerobes are thought to produce more extensive tissue necrosis in polymicrobial infections in which virulence factors of the various bacteria can act synergistically to cause more significant tissue destruction.

• The pathogenesis of secondary abscesses depends on the predisposing factor.

• In cases of bronchial obstruction from malignancy or a foreign body, the obstructing lesion prevents clearance of oropharyngeal secretions, leading to abscess development.

• With underlying systemic conditions (e.g., immunosuppression after bone marrow or solid organ transplantation), impaired host defense mechanisms lead to increased susceptibility to the development of lung abscesses caused by a broad range of pathogens, including opportunistic organisms.

• Lung abscesses also arise from septic emboli, either in tricuspid and valve endocarditis (often involving Staphylococcus aureus) or in Lemierre's syndrome, in which an infection begins in the pharynx (classically involving Fusobacterium necrophorum) and then spreads to the neck and the carotid sheath (which contains the jugular vein) to cause septic thrombophlebitis.

3.1 Pathogens

• Primary lung abscess (often with risk factors for aspiration): Anaerobes (e.g., Peptostreptococcus spp., Prevotella spp., Bacteroides spp., milleri group streptococci), microaerophilic streptococci.

• Secondary lung abscess (often with underlying immunocompromise): Staphylococcus aureus, gram-negative rods (e.g., Pseudomonas aeruginosa, Enterobacteriaceae), Nocardia spp., Aspergillus spp., Mucorales, Cryptococcus spp., Legionella spp., Rhodococcus equi, Pneumocystis jirovecii.

• Embolic lesions: Staphylococcus aureus (often from endocarditis), Fusobacterium necrophorum (Lemierre's syndrome).

• Endemic infections (with or without underlying immunocompromise): Mycobacterium tuberculosis (as well as Mycobacterium avium and Mycobacterium kansasii), Coccidioides spp., Histoplasma capsulatum, Blastomyces spp., parasites (e.g., Entamoeba histolytica, Paragonimus westermani, Strongyloides stercoralis).

• Miscellaneous conditions: Bacterial pathogen (often S. aureus) after influenza or another viral infection, Actinomyces spp.

Table 1 Table 132-1 Examples of Microbial Pathogens That Can Cause Lung Abscesses

Clinical Condition	Pathogens
Primary lung abscess (often with risk factors for aspiration)	Anaerobes (e.g., Peptostreptococcus spp., Prevotella spp., Bacteroides spp., milleri group streptococci), microaerophilic streptococci
Secondary lung abscess (often with underlying immunocompromise)	Staphylococcus aureus, gram-negative rods (e.g., Pseudomonas aeruginosa, Enterobacteriaceae), Nocardia spp., Aspergillus spp., Mucorales, Cryptococcus spp., Legionella spp., Rhodococcus equi, Pneumocystis jirovecii
Embolic lesions	Staphylococcus aureus (often from endocarditis), Fusobacterium necrophorum (Lemierre's syndrome; see text for details)
Endemic infections (with or without underlying immunocompromise)	Mycobacterium tuberculosis (as well as Mycobacterium avium and Mycobacterium kansasii), Coccidioides spp., Histoplasma capsulatum, Blastomyces spp., parasites (e.g., Entamoeba histolytica, Paragonimus westermani, Strongyloides stercoralis)
Miscellaneous conditions	Bacterial pathogen (often S. aureus) after influenza or another viral infection, Actinomyces spp.

3.2 Pathogenesis

- Aspiration of oral flora (anaerobes, microaerophilic streptococci) into the lung parenchyma in a susceptible host.
- Pneumonitis develops initially (exacerbated in part by tissue damage caused by gastric acid).
- Over a period of 7–14 days, bacteria produce parenchymal necrosis and cavitation.
- Extent depends on host–pathogen interaction.
- Anaerobes produce more extensive tissue necrosis in polymicrobial infections.
- Synergistic virulence factors of various bacteria cause more significant tissue destruction.

4. CLINICAL FEATURES

- Clinical manifestations initially may be similar to those of pneumonia, with fevers, cough, sputum production, and chest pain.
- A more chronic and indolent presentation that includes night sweats, fatigue, and anemia is often observed with anaerobic lung abscesses.
- A subset of patients with putrid lung abscesses may report discolored phlegm and foul-tasting or foul-smelling sputum.
- Patients with lung abscesses due to non-anaerobic organisms, such as S. aureus, may present with a more fulminant course characterized by high fevers and rapid progression.
- Findings on physical examination may include fevers, poor dentition, and/or gingival disease.
- Physical exam may include amphoric and/or cavernous breath sounds on lung auscultation.
- Additional findings may include digital clubbing and the absence of a gag reflex.

4.1 Physical Examination

- Fevers, poor dentition, gingival disease.
- Amphoric and/or cavernous breath sounds on lung auscultation.
- Digital clubbing.
- Absence of a gag reflex.

5. DIFFERENTIAL DIAGNOSIS

- The differential diagnosis of lung abscesses is broad and includes other noninfectious processes that result in cavitary lung lesions.
- Includes lung infarction, malignancy, sequestration, cryptogenic organizing pneumonia, sarcoidosis, vasculitides and autoimmune diseases (e.g., granulomatosis with polyangiitis).
- Includes lung cysts or bullae containing fluid.
- Includes septic emboli (e.g., from tricuspid valve endocarditis).
- Other less common entities can include pulmonary manifestations of diseases that usually present at locations other than the chest (e.g., inflammatory bowel disease, pyoderma gangrenosum).

5.1 Cavitary Lesions

- Lung infarction.
- Malignancy.
- Sequestration.
- Cryptogenic organizing pneumonia.

• Sarcoidosis.

• Vasculitides and autoimmune diseases (e.g., granulomatosis with polyangiitis).

• Lung cysts or bullae containing fluid.

• Septic emboli (e.g., from tricuspid valve endocarditis).

• Pulmonary manifestations of diseases that usually present at locations other than the chest (e.g., inflammatory bowel disease, pyoderma gangrenosum).

6. INVESTIGATIONS & DIAGNOSIS

• Lung abscesses are documented by chest imaging.

• Although a chest radiograph usually detects a thick-walled cavity with an air-fluid level, CT permits better definition and may provide earlier evidence of cavitation.

• CT may also yield additional information regarding a possible underlying cause of lung abscess, such as malignancy, and may help distinguish a peripheral lung abscess from a pleural infection.

• This distinction has important implications for treatment because a pleural space infection, such as an empyema, may require urgent drainage.

• More invasive diagnostics (such as transtracheal aspiration) were traditionally undertaken for primary lung abscesses, whereas empirical therapy that includes drugs targeting anaerobic organisms currently is used more often.

• While sputum can be collected noninvasively for Gram's stain and culture, which may yield a pathogen, the infection is likely to be polymicrobial, and culture results may not reflect the presence of anaerobic organisms.

• Increasing use of molecular techniques for bacterial detection (e.g., 16S RNA gene amplification) may eventually yield more specific pathogen identification.

• Many physicians consider putrid-smelling sputum to be virtually diagnostic of an anaerobic infection.

• When a secondary lung abscess is present or empirical therapy fails to elicit a response, sputum and blood cultures are advised in addition to serologic studies for opportunistic pathogens (e.g., viruses and fungi causing infections in immunocompromised hosts).

• Additional diagnostics, such as bronchoscopy with bronchoalveolar lavage or protected brush specimen collection and CT-guided percutaneous needle aspiration, can be undertaken.

• Risks posed by these more invasive diagnostics include spillage of abscess contents into the other lung (with bronchoscopy) and pneumothorax and bronchopleural fistula development (especially with CT-guided needle aspiration).

• Early diagnostics in secondary abscesses, especially in immunocompromised hosts, are particularly important because the patients involved may be especially fragile, at risk for infection with a broad array of pathogens, and therefore less likely than other patients to respond to empirical therapy.

6.1 Imaging

• Chest Radiograph: Thick-walled cavity with air-fluid level.

• CT: Better definition, earlier evidence of cavitation, identifies underlying cause (e.g., malignancy), distinguishes peripheral abscess from pleural infection.

6.2 Microbiology

• Sputum: Noninvasive, Gram's stain and culture, may yield pathogen, likely polymicrobial, culture results may not reflect anaerobes.

• Putrid sputum: Virtually diagnostic of anaerobic infection.

• Blood cultures: Advised in secondary abscess or if empirical therapy fails.

• Serologic studies: For opportunistic pathogens (viruses, fungi) in immunocompromised hosts.

• Bronchoscopy/BAL: Invasive, risk of spillage.

• CT-guided aspiration: Invasive, risk of pneumothorax and bronchopleural fistula.

7. MANAGEMENT & TREATMENT

• The availability of antibiotics in the 1940s and 1950s established therapy with this drug class as the primary approach to the treatment of lung abscess.

• Previously, surgery had been relied upon much more frequently.

• For many decades, penicillin was the antibiotic of choice for primary lung abscesses in light of its anaerobic coverage.

• However, because oral anaerobes can produce beta-lactamases, clindamycin has proved superior to penicillin in clinical trials.

• For primary lung abscesses, the recommended regimens are (1) clindamycin (600 mg IV three times daily; then, with the disappearance of fever and clinical improvement, 300 mg PO four times daily) or (2) IV-administered beta-lactam/beta-lactamase combination, followed—once the patient's condition is stable—by orally administered amoxicillin-clavulanate.

• This therapy should be continued until imaging demonstrates that the lung abscess has cleared or regressed to a small scar.

• Treatment duration may range from 3–4 weeks to as long as 14 weeks, with some literature suggesting that a course of at least 6 weeks may be associated with better outcomes.

7.1 Pharmacologic Therapy

• Clindamycin: 600 mg IV three times daily -> 300 mg PO four times daily (with disappearance of fever and clinical improvement).

• Beta-lactam/Beta-lactamase combination: IV-administered -> orally administered amoxicillin-clavulanate (once condition is stable).

• Duration: 3–4 weeks to 14 weeks (at least 6 weeks suggested for better outcomes).

• Goal: Continue until imaging demonstrates abscess cleared or regressed to small scar.

Table 2 Table: Recommended Regimens for Primary Lung Abscess

Drug	Dose	Frequency	Monitoring	Key Side Effects	Contraindications
Clindamycin	600 mg IV	Three times daily	Fever,clinical improvement	Diarrhea, rash	None specified
Clindamycin (Oral)	300 mg PO	Four times daily	Fever,clinical improvement	Diarrhea, rash	None specified
Amoxicillin-clavulanate	Oral	Once condition stable	Fever,clinical improvement	Diarrhea, rash	None specified
Beta-lactam/Beta-lactamase	IV-administered	Once condition stable	Fever,clinical improvement	Diarrhea, rash	None specified

7.2 Surgical Considerations

- Previously, surgery had been relied upon much more frequently.
- The availability of antibiotics established drug class as primary approach.
- Surgery is now less frequent.

8. PROGNOSIS & COMPLICATIONS

- The availability of antibiotics in the 1940s and 1950s significantly reduced the incidence of and mortality rate from lung abscess.
- Lung abscesses are still a source of significant morbidity and mortality.
- Complications may include pleural space infection (empyema) requiring urgent drainage.
- Invasive diagnostics carry risks of spillage of abscess contents into the other lung and pneumothorax and bronchopleural fistula development.

8.1 Complications

- Pleural space infection (empyema) requiring urgent drainage.
- Spillage of abscess contents into the other lung (with bronchoscopy).
- Pneumothorax and bronchopleural fistula development (especially with CT-guided needle aspiration).

9. SPECIAL CONSIDERATIONS

- Immunocompromised hosts and patients without the classic presentation of a primary lung abscess can be infected with a wide array of unusual organisms.
- Because immunocompromised hosts and patients without the classic presentation of a primary lung abscess can be infected with a wide array of unusual organisms, it is of special importance to obtain culture material to target therapy.
- Early diagnostics in secondary abscesses, especially in immunocompromised hosts, are particularly important because the patients involved may be especially fragile, at risk for infection with a broad array of pathogens, and therefore less likely than other patients to respond to empirical therapy.

9.1 Immunocompromised Hosts

- Risk for infection with a broad array of pathogens.
- Less likely to respond to empirical therapy.
- Special importance to obtain culture material to target therapy.
- Pathogens include opportunistic organisms (Table 132-1).

10. KEY PEARLS & CLINICAL TRAPS

- Putrid-smelling sputum is virtually diagnostic of an anaerobic infection.
- Right lung is affected more commonly than the left because the right mainstem bronchus is less angulated.
- Primary abscesses are polymicrobial, primarily including anaerobic organisms and microaerophilic streptococci.
- Secondary abscesses often involve Pseudomonas aeruginosa, Staphylococcus aureus, or opportunistic fungi in immunocompromised hosts.
- Treatment duration may range from 3–4 weeks to as long as 14 weeks, with some literature suggesting that a course of at least 6 weeks may be associated with better outcomes.

• CT may also yield additional information regarding a possible underlying cause of lung abscess, such as malignancy, and may help distinguish a peripheral lung abscess from a pleural infection.

• This distinction has important implications for treatment because a pleural space infection, such as an empyema, may require urgent drainage.

• Many physicians consider it extremely rare for lung abscesses to develop in the absence of teeth as a nidus for bacterial colonization.

10.1 Diagnostic Clues

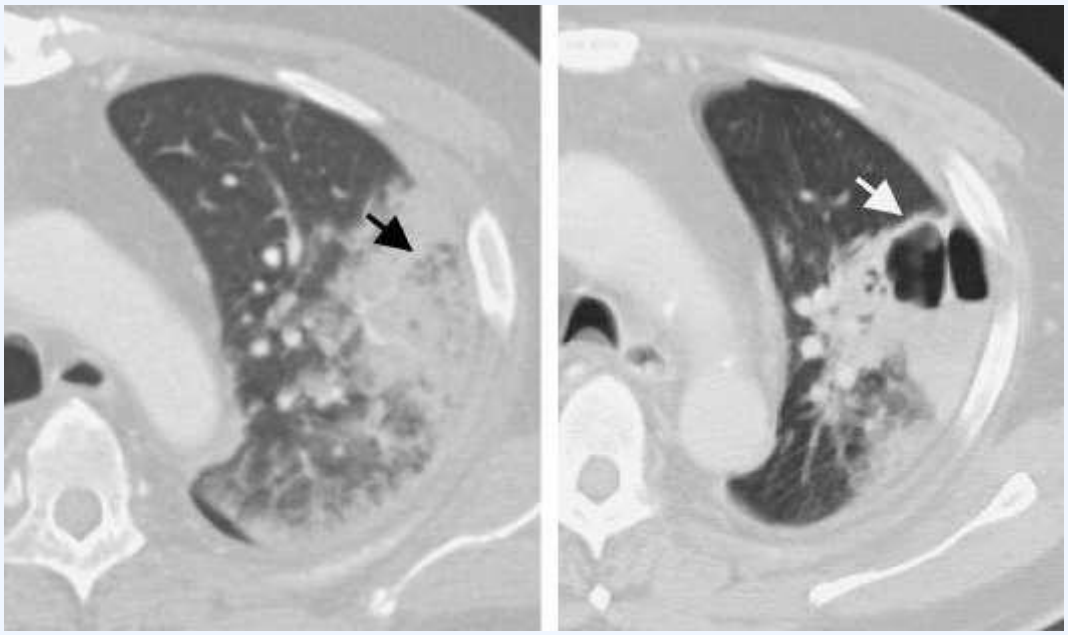
• Thick-walled cavity with an air-fluid level on CXR.

• Putrid-smelling sputum.

• Amphoric and/or cavernous breath sounds on lung auscultation.

• Digital clubbing.

FIGURES & ILLUSTRATIONS — FROM HARRISON'S



Harrison's 22e · Figure 1

FIGURE 132-1 Representative chest CT scans demonstrating development of lung abscesses. This patient was immunocompromised from underlying lymphoma and developed severe Pseudomonas aeruginosa pneumonia, as represented by a left lung infiltrate with concern for central regions of necrosis (panel A, black arrow). Two weeks later, areas of cavitation with air-fluid levels were visible in this region and were consistent with the development of lung abscesses (panel B, white arrow). (Images provided by Dr. Ritu Gill, formerly of the Division of Chest Radiology, Brigham and Women's Hospital, Boston; with permission.) — Representative chest CT scans demonstrating development of lung abscesses. Panel A shows a left lung infiltrate with concern for central regions of necrosis in an immunocompromised patient with lymphoma and Pseudomonas aeruginosa pneumonia (black arrow). Panel B shows areas of cavitation with air-fluid levels visible two weeks later, consistent with lung abscess development (white arrow).