胸腔影像學概論
Chest imaging
【胸部X光片 VI 】

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學習目標：

- 胸部X光的基本判讀
- 討論各種肺感染
- 討論肺血管的病變

Reference

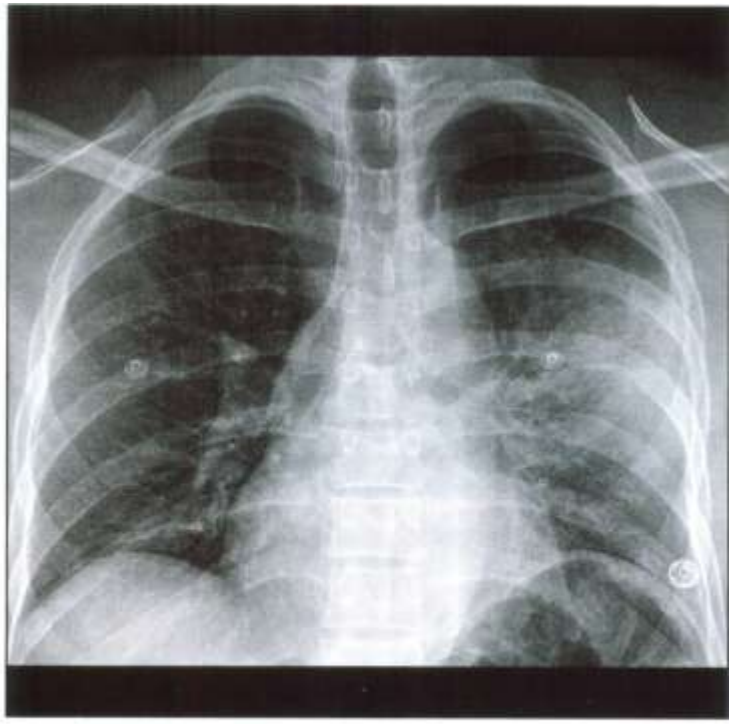
- **Jud W. Gurney ... et al. (2006). *Diagnostic imaging*. Salt Lake City, Utah: Amirsys.**
- **Jannette Collins, Eric J. Stern. (1999). *Chest radiology : the essentials* . Philadelphia : Lippincott Williams & Wilkins.**
- **Alfred P. Fishman; section editors, Jack A. Elias ... et al. (1998). *Fishman's pulmonary diseases and disorders*. New York：McGraw-Hill, Health Professions Division.**
- 江自得（**2003**）。實用胸腔**X**光診斷學。臺北：力大。
- 葉育文（譯）**(2005)**。胸部**X**光臨床判讀（原作者：**Paul F. Jenkins**）。台北：合記。

Diagnostic Imaging (1)

- **Infection**
- **Pulmonary congestion**

Bacterial Pneumonia (1)

Graphic shows how inflammatory exudate begins in distal air spaces spreading through the airways to adjacent alveoli. Eventually will spread to adjacent segments through pores of Kohn.



Frontal radiograph shows focal lobar consolidation in the left upper lobe. No complications: Pleural effusion, cavitation, or adenopathy. Most common community acquired pneumonia is S. pneumonia.

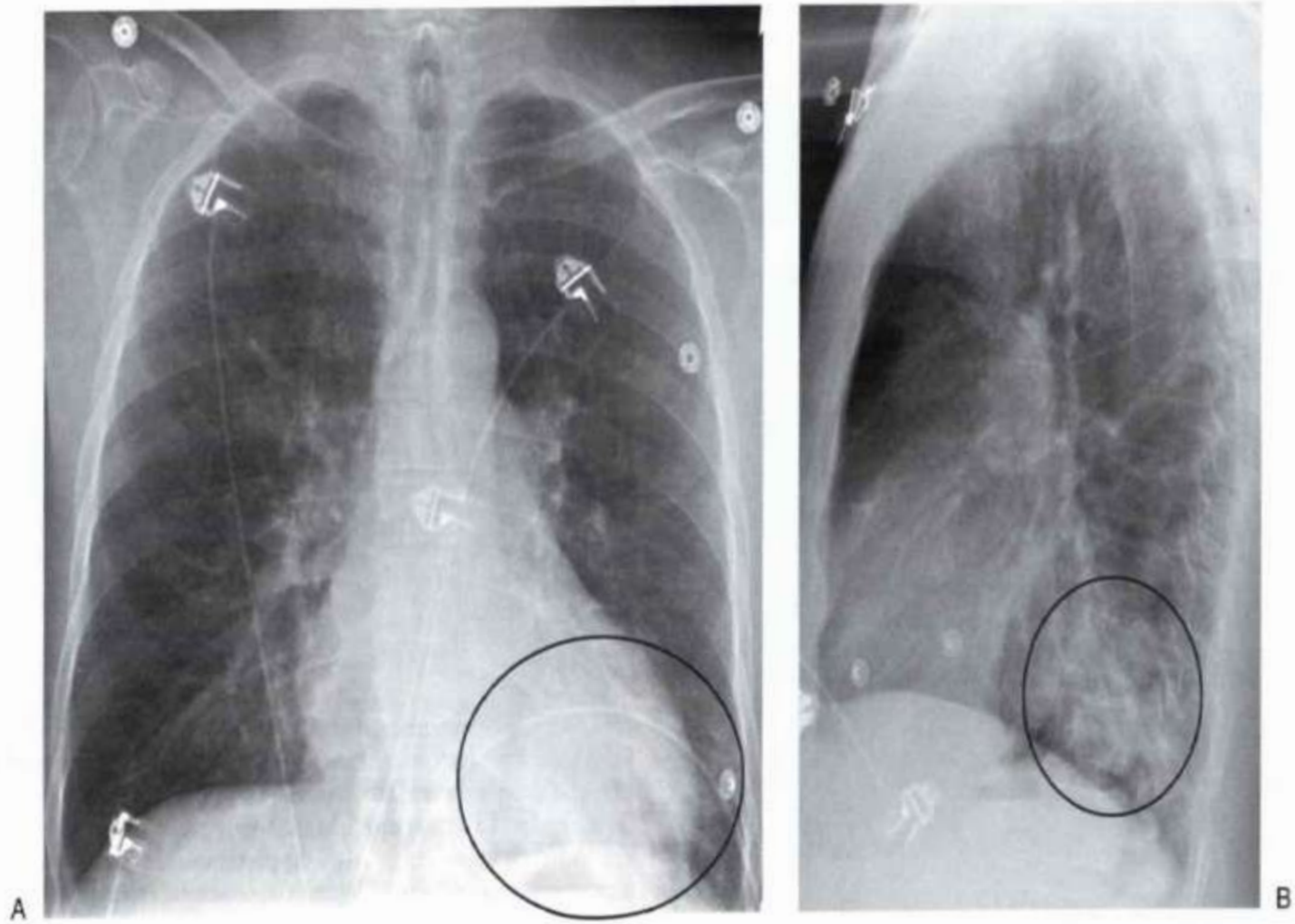


FIGURE 4-7. **Bacterial pneumonia.** This 58-year-old man presented with diabetic ketoacidosis, fever, cough, and elevated white blood cell count. **A:** PA chest radiograph shows ALD in the left lower lobe (*circle*). **B:** Lateral view shows ALD overlying the spine posteriorly (the so-called "spine sign"; *circle*).

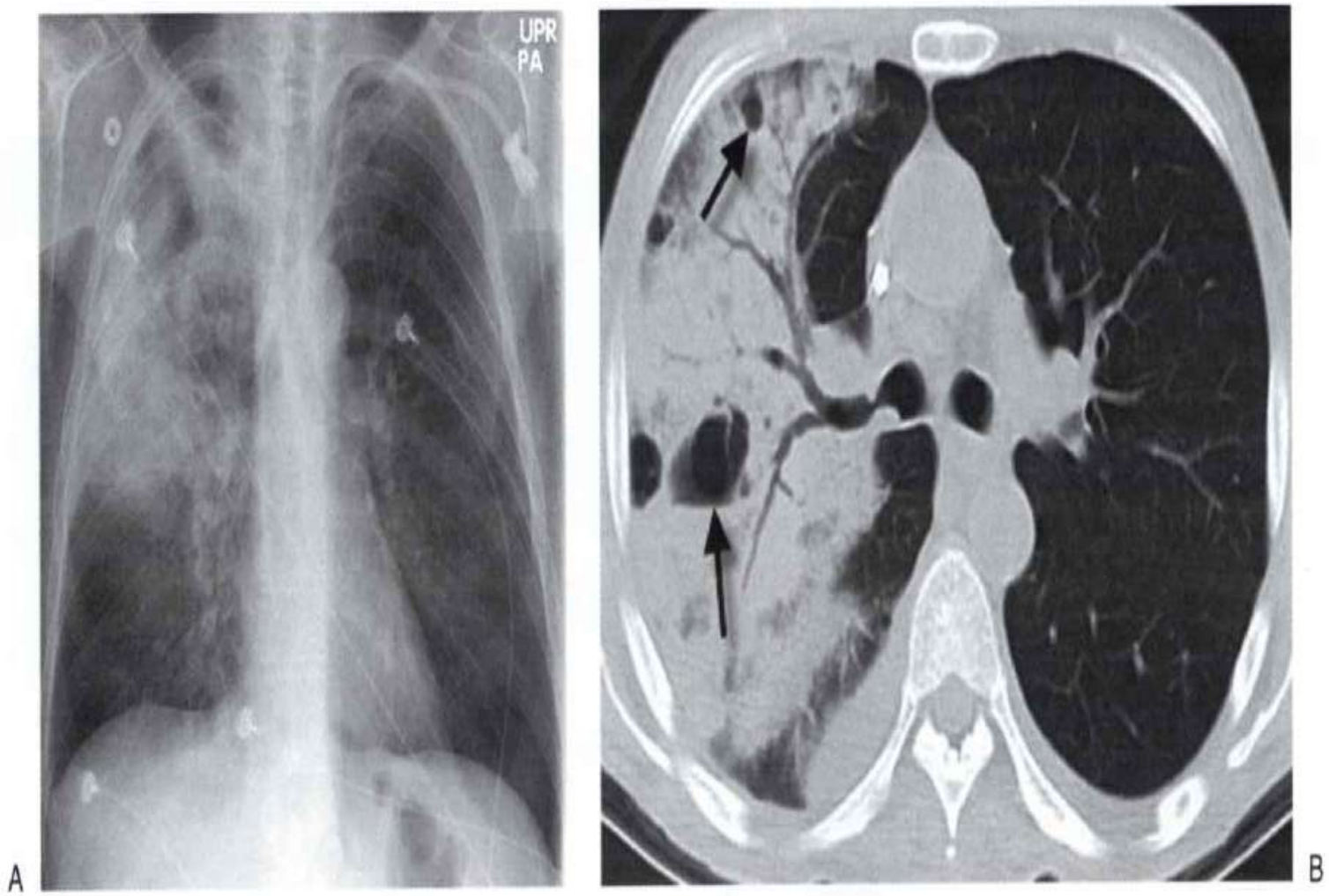
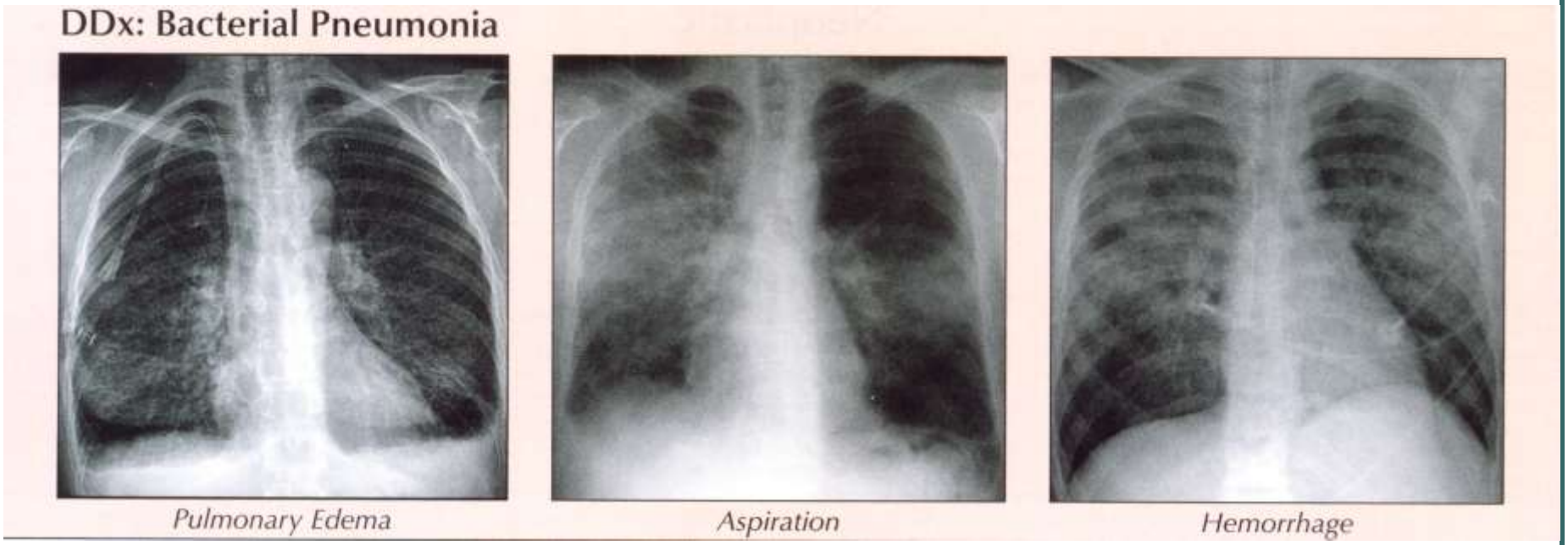


FIGURE 4-13. Necrotizing *Pseudomonas* pneumonia. **A:** PA chest radiograph shows ALD in the right upper and middle lung. **B:** CT shows numerous lucent areas with air–fluid levels (*arrows*) within the densely opacified lung, consistent with lung necrosis. Also shown are prominent air bronchograms.

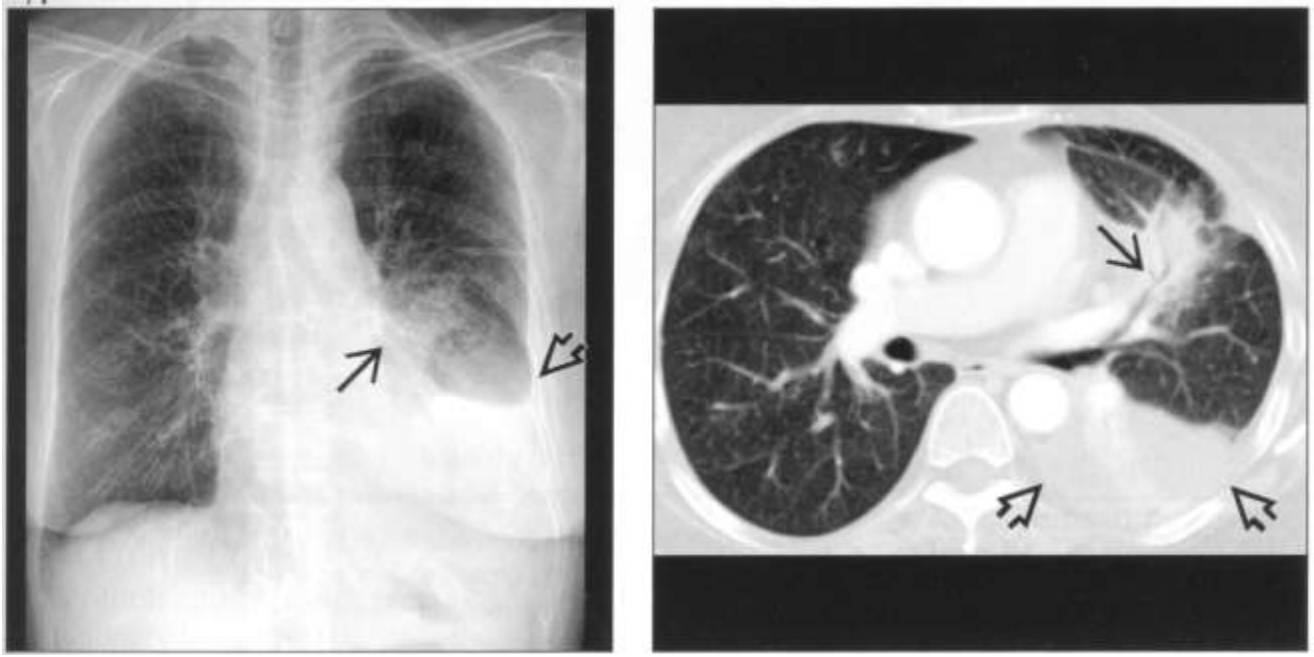
Bacterial Pneumonia (2)



Bacterial Pneumonia (3)

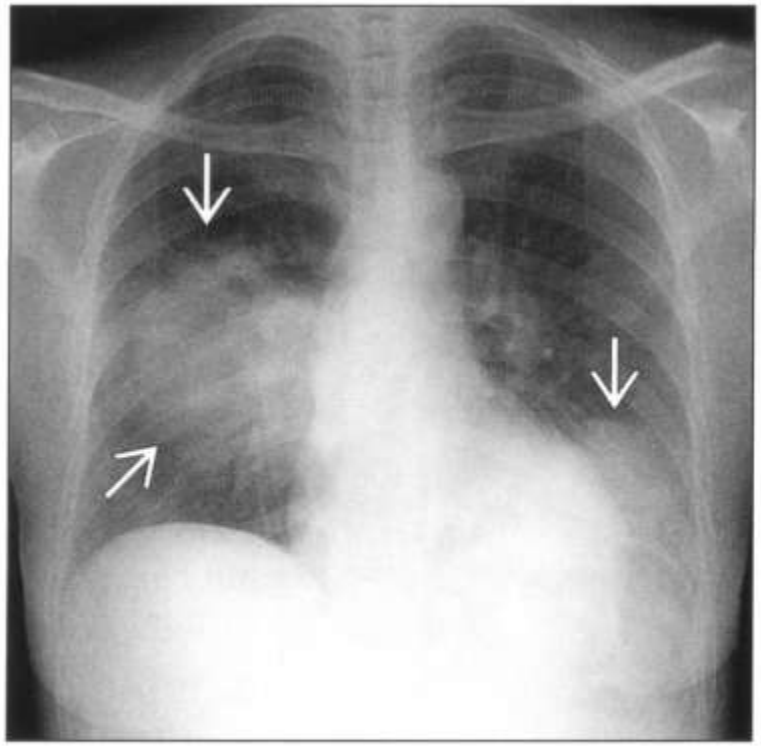
Image Gallery

Typical



(Left) *Frontal radiograph shows lingular consolidation (arrow) and moderate sized left pleural effusion (open arrow). In pneumonia, effusion may be either parapneumonic or empyema.* ***(Right)*** *Axial CECT shows the lingular pneumonia with air bronchogram (arrow) and the pleural effusion (open arrows) with adjacent passive atelectasis left lower lobe. Diagnostic tap demonstrated an exudative parapneumonic effusion.*

Staphylococcus Pneumonia (1)



Frontal radiograph shows bilateral lower lobe dense opacities (arrows) from this patient with bilateral methicillin-sensitive Staphylococcus pneumonia. No effusions evident.

Axial CECT shows dense consolidation in the right lower lobe and multiple small patchy areas of opacity in the right upper lobe, as a result of methicillin-sensitive Staphylococcus pneumonia.

Staphylococcus Pneumonia (2)

Key Facts

Imaging Findings

- Rapid onset patchy or lobar consolidation, marked by widespread, rapid, severe lung destruction with abscess formation
- Location: Patchy bronchopneumonia with a multisegmental distribution, frequently bilateral

Top Differential Diagnoses

- Other Bacterial Pneumonias

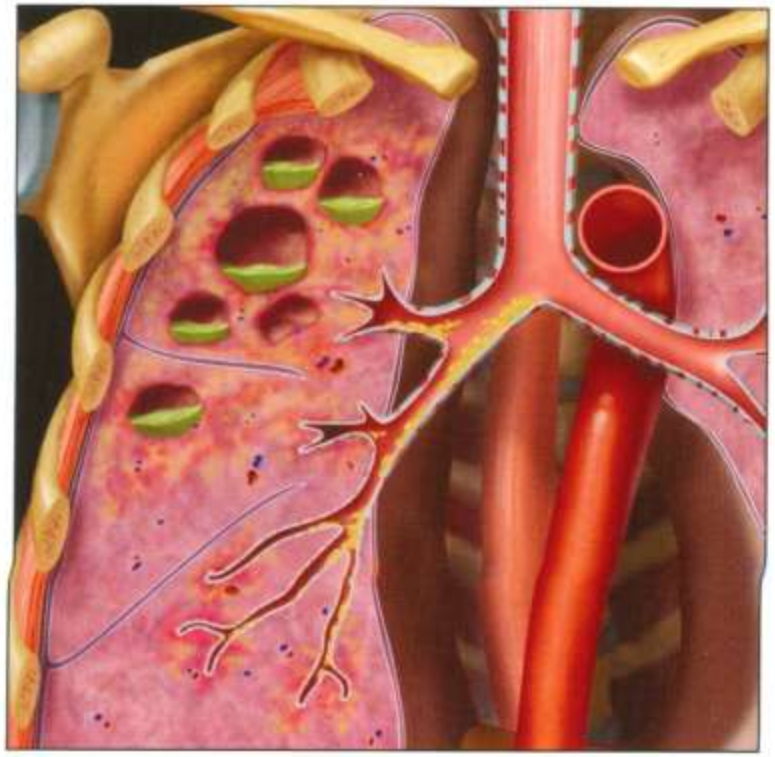
Pathology

- Most common bronchopneumonia
- Common cause of death during outbreaks of influenza

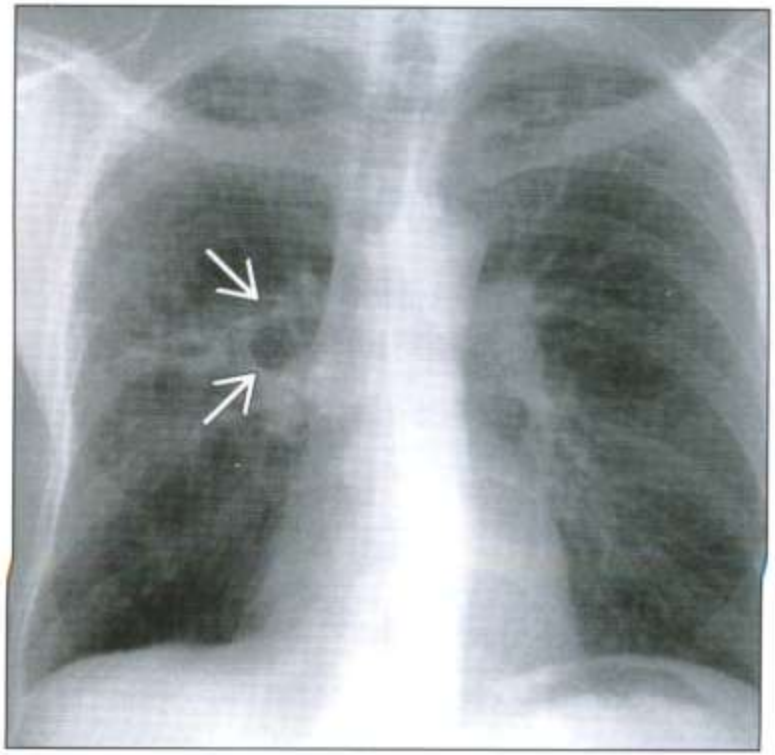
Clinical Issues

- Age: Children and elderly more susceptible, especially as sequelae to influenza

Mycobacterial Pneumonia (1)



Coronal graphic shows reactivation tuberculosis with cavitary disease in the apical lung segments. Bronchogenic spread to the dependent right lower lobe and apical pleural thickening are also seen.



Frontal radiograph shows distortion of lung markings in the right upper lobe with cavitation (arrows) consistent with fibrosis and bronchiectasis from reactivation tuberculosis.

Mycobacterial Pneumonia (2)

Key Facts

Terminology

- Indolent bacterial (mycobacterium tuberculosis) infection, often relapsing course, associated with fibrosis, calcification and adenopathy
- Varying appearance depending on time course

Imaging Findings

- Primary: Airspace consolidation with adenopathy, effusion common
- Miliary: Diffuse tiny relatively well-defined nodules without adenopathy or effusion
- Reactivation: Apical fibrosis, cavitation, calcification
- Most infected patients have a + purified protein derivative (PPD) and a normal chest radiograph
- May also involve spine (Pott disease)
- May present with adenopathy alone

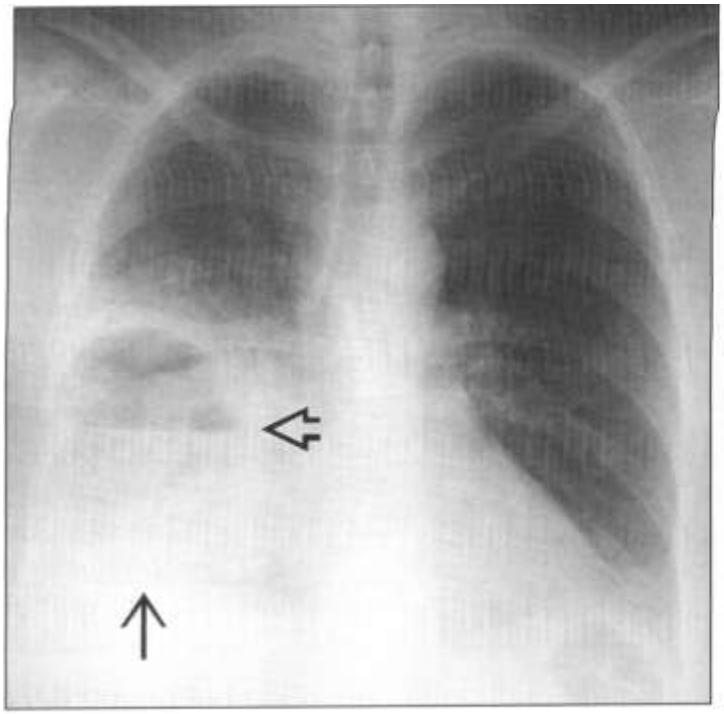
Top Differential Diagnoses

- Chronic Fungal Infection
- Ankylosing Spondylitis
- Progressive Massive Fibrosis (PMF)
- Sarcoidosis
- Bronchogenic Carcinoma
- Pulmonary Lymphoma

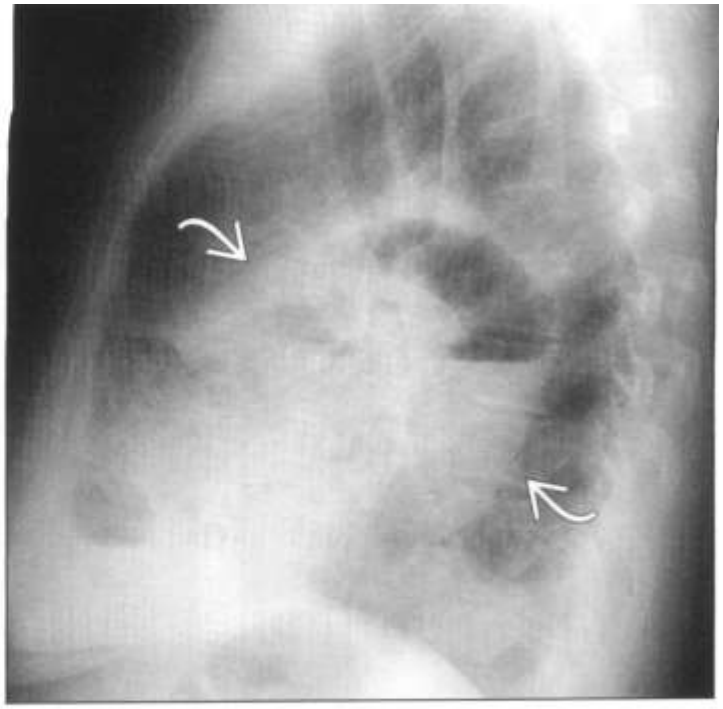
Pathology

- Increased susceptibility in patients with impaired cellular immunity
- Incidence world-wide has increased in part due to Human immunodeficiency virus (HIV) infection
- Acid-fast bacilli located in macrophages, obligate aerobe

Lung Abscess (1)



Frontal radiograph shows airspace opacification in the right lower lung (arrow) with a large cavity and an air fluid level (open arrow).



Lateral radiograph shows an abscess in an over-expanded right middle lobe (curved arrows). The location suggests aspiration. Cultures showed mixed aerobic and anaerobic bacteria.

Lung Abscess (2)

Key Facts

Imaging Findings

- Irregular thick walled cavity, often containing air fluid level
- May begin as a focus of consolidation and evolve into an abscess over days or weeks
- Often in dependent lung because a common cause is aspiration
- Posterior segments of upper lobes or superior segments of lower lobes, in supine patients
- Initially, fluid filled cavity may appear mass-like
- Cavity: Spherical, equal air fluid levels on frontal and lateral views, acute angles with chest wall
- Abscess: Thick, irregular wall, spherical, small contact with chest wall, bronchovascular markings extend toward the abscess
- Bronchopleural fistula: Development of hydropneumothorax, empyema

Top Differential Diagnoses

- Pneumatocele Formation
- Other infections: Tuberculosis (TB), fungal infections, Pneumocystis pneumonia (PCP)
- Neoplasm: Primary lung or metastases (squamous cell carcinoma, adenocarcinoma), lymphoma

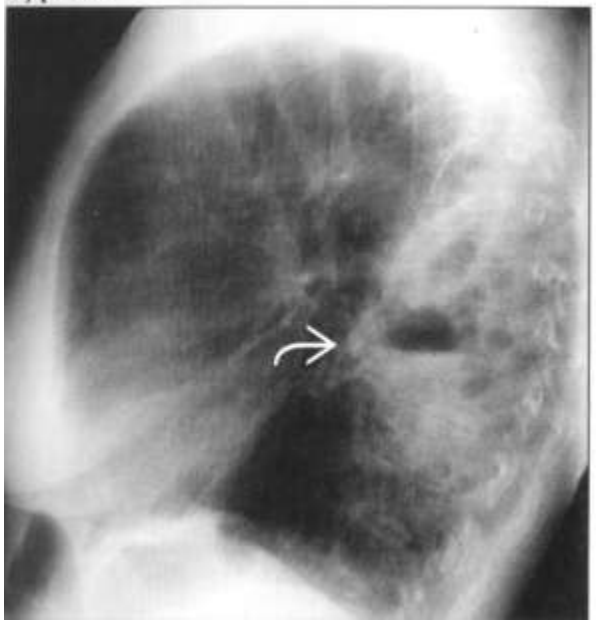
Clinical Issues

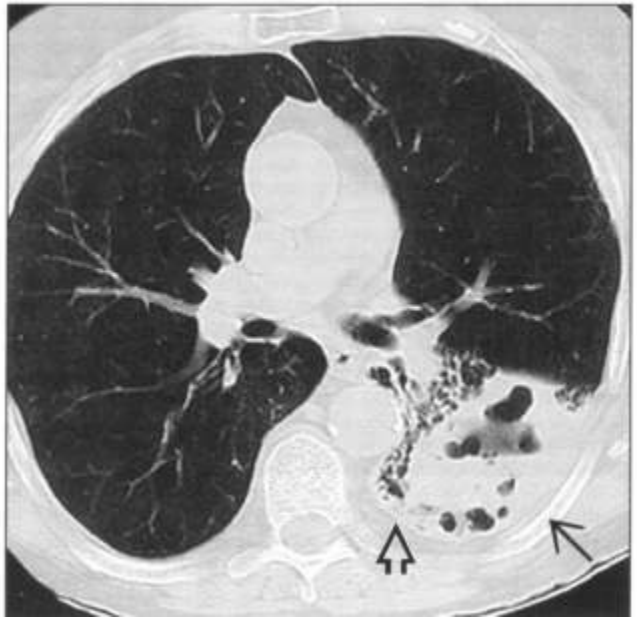
- Good prognosis with early diagnosis and treatment
- Bronchoscopy to assess for an endobronchial lesion or foreign body if medical treatment has failed
- Percutaneous drainage, controversial

Lung Abscess (3)

Image Gallery

Typical

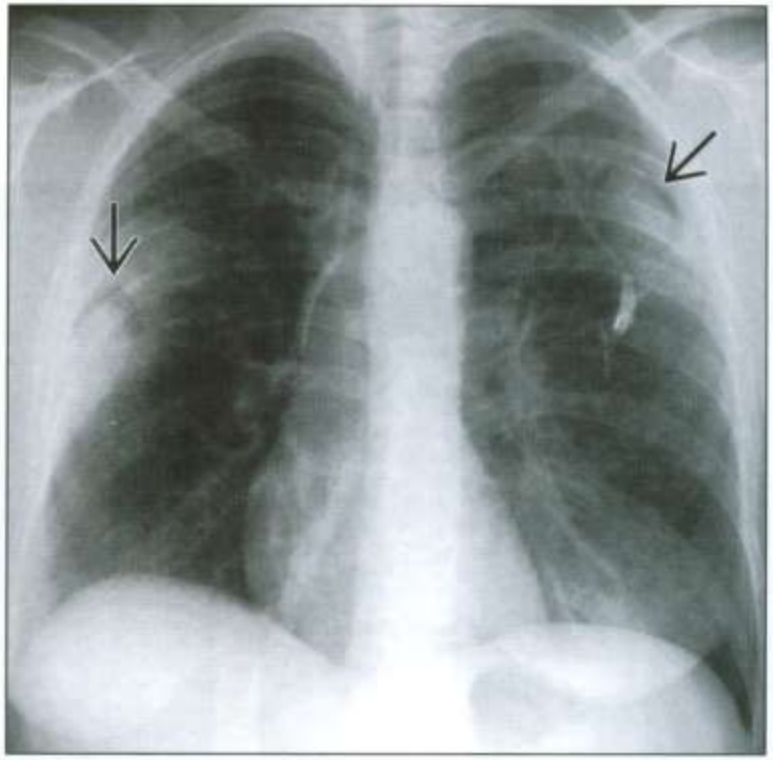




(Left) *Lateral radiograph shows an abscess in the superior segment of the left lower lobe (curved arrow), a typical location for aspiration in the supine position.* ***(Right)*** *Axial CECT shows a spherical abscess with air fluid levels (arrow) and acute (open arrow) and obtuse angles to chest wall. Lung markings extend to the margins. Diagnosis: Pseudomonas abscess*

Aspergillosis (1)

Coronal graphic shows multiple foci of invasive aspergillosis with central necrotic lung balls, surrounding air crescents & halos of peripheral hemorrhage.



Frontal radiograph shows bilateral foci of invasive aspergillosis with surrounding air crescents (arrows) in a 33 year old woman after bone marrow transplant.

Aspergillosis (2)

Key Facts

Imaging Findings

- Invasive aspergillosis: CT halo sign
- Ground-glass opacity, usually related to hemorrhage, surrounding a nodule, mass or focus of consolidation
- Aspergilloma: Dependent, rounded or oval nodule developing in cavity or cyst

Top Differential Diagnoses

- Other Fungi
- Mycobacterial Pneumonia
- Bacterial Pneumonia
- Pulmonary Emboli
- Wegener Granulomatosis, Pulmonary
- Non-Small Cell Lung Cancer

Pathology

- Etiology: Most aspergillus infections are caused by aspergillus fumigatus

Clinical Issues

- Patients with mycetoma are at risk for hemoptysis, which can be massive

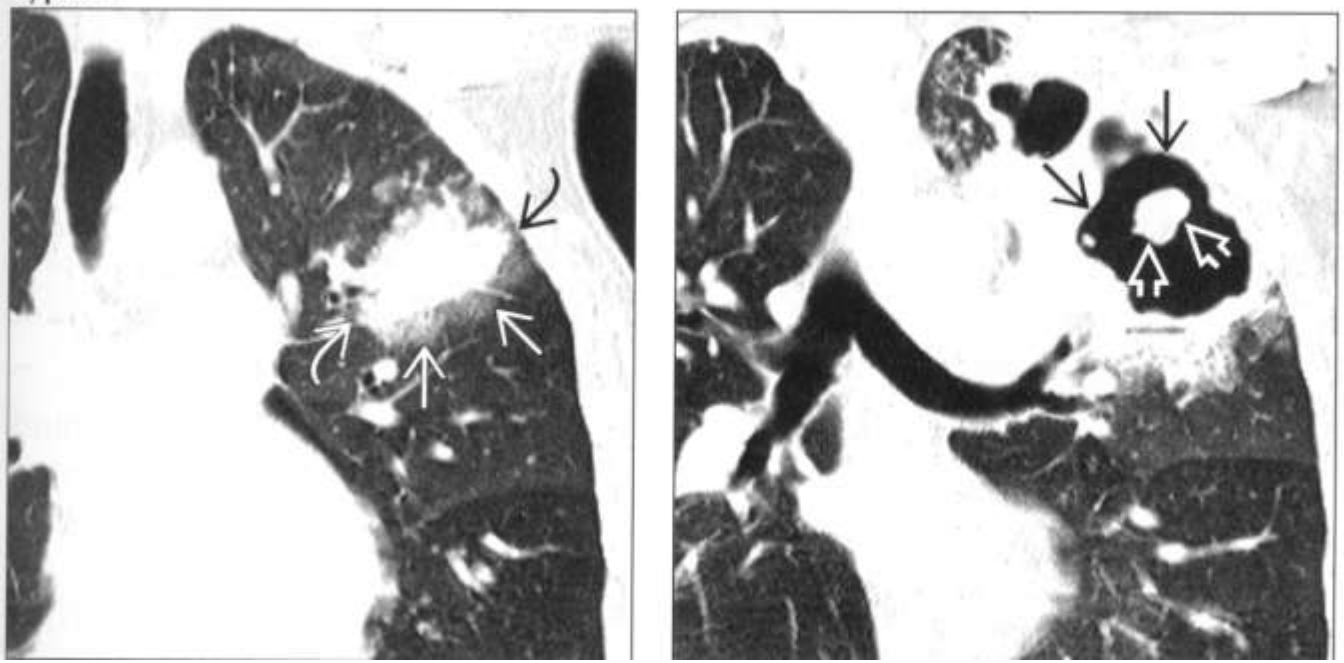
Diagnostic Checklist

- Sentinel sign for mycetoma
- Development of pleural thickening adjacent to a pre-existing cavity
- Such a cavity should be examined for a mycetoma & observed closely on subsequent exams
- Development of a low density rim around an area of invasive aspergillosis can indicate improvement in neutropenia

Aspergillosis (3)

Image Gallery

Typical



(Left) *Coronal CECT shows central consolidation from invasive aspergillosis (curved arrows) & a surrounding halo of ground-glass opacity (arrows), consistent with hemorrhage from angioinvasion.* ***(Right)*** *Coronal CECT from same patient later in hospital course shows gas (arrows) surrounding a ball of necrotic lung (open arrows) within a dense focus of consolidation (crescent sign) related to angioinvasive aspergillosis.*

Eosinophilic Pneumonia (1)

Key Facts

Terminology
- Acute eosinophilic pneumonia (AEP)
- Chronic eosinophilic pneumonia (CEP)
- Acute and chronic pneumonias due to eosinophilic infiltration with or without blood eosinophilia

Imaging Findings
- AEP: Mimics pulmonary edema (bilateral alveolar and interstitial opacities)
- CEP: Photographic negative of pulmonary edema (peripheral consolidation)
- Chest radiograph usually suffices for diagnosis and follow-up

Top Differential Diagnoses
- Cryptogenic Organizing Pneumonia (COP)
- Pulmonary Infarcts
- Aspiration Pneumonia

Pathology
- AEP: Diffuse alveolar damage (acute or organizing) associated with large number of interstitial and alveolar eosinophils
- CEP: Filling of alveolar air spaces by inflammatory infiltrate with a high proportion of eosinophils

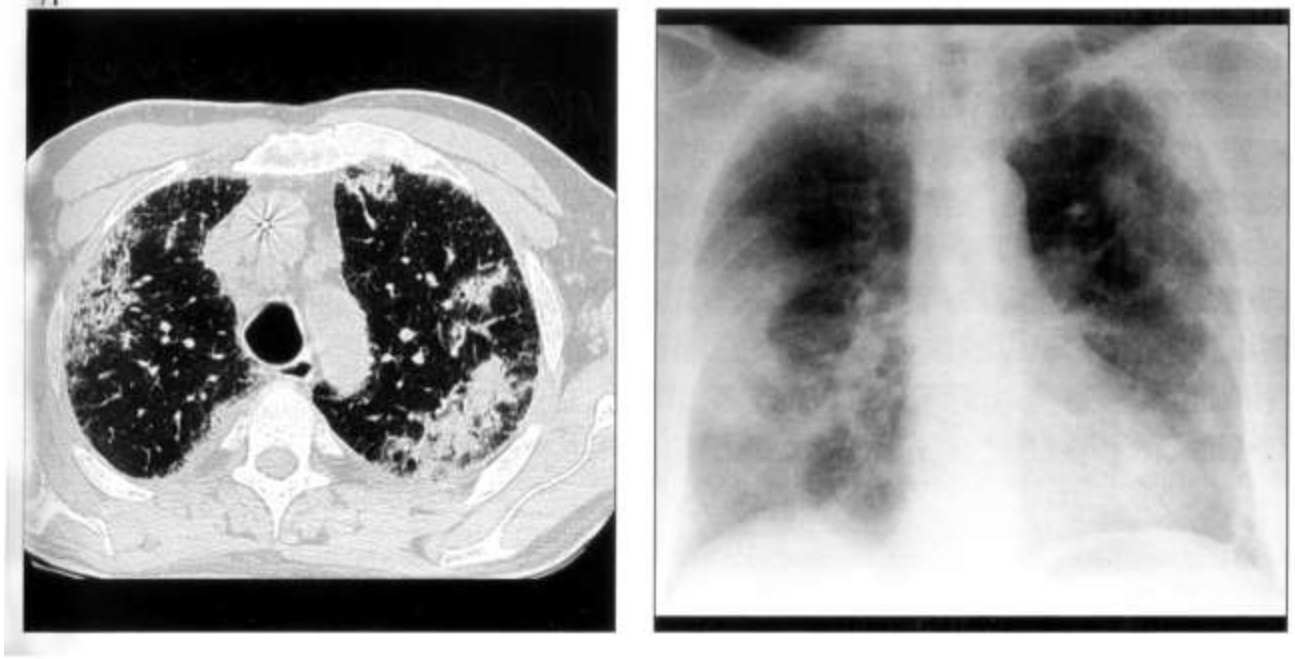
Clinical Issues
- Both AEP and CEP show rapid response to corticosteroid therapy
- Relapse unusual in AEP but common in CEP

Diagnostic Checklist
- Peripheral band-like opacities paralleling chest wall subtle clue to the diagnosis

Eosinophilic Pneumonia (2)

Image Gallery

Typical



(Left) *Axial HRCT shows bilateral peripheral areas of consolidation and ground-glass opacity in patient with CEP.* ***(Right)*** *Radiograph shows bilateral peripheral areas of consolidation (photographic negative of pulmonary edema) due to CEP.*

Acute Interstitial Pneumonia (1)

Key Facts

Terminology
- Rapidly progressive disorder of unknown etiology characterized by diffuse alveolar damage on biopsy

Imaging Findings
- Best diagnostic clue: Diffuse apparently symmetrical air space opacification
- Diffuse bilateral and symmetrical air space opacification
- Bilateral abnormalities most common in lower zone and dependent lung
- Ground-glass opacification
- Dense parenchymal opacification
- Architectural distortion
- Honeycombing
- Traction bronchiectasis/bronchiolectasis

Top Differential Diagnoses
- Acute Respiratory Distress Syndrome (ARDS)
- Hydrostatic Pulmonary Edema
- Diffuse Intraalveolar Hemorrhage
- Alveolar Proteinosis (and Potentially Other Causes of a "Crazy-Paving" Pattern)
- Disseminated Infection (e.g., Pneumocystis Jiroveci Pneumonia)
- Accelerated Idiopathic Pulmonary Fibrosis (IPF)
- Adenocarcinoma/Bronchoalveolar Cell Carcinoma

Pathology
- Diffuse alveolar damage is the histopathologic hallmark and evolves through three (overlapping) stages

Acute Interstitial Pneumonia (2)

Image Gallery

Typical

(Left) *Frontal radiograph with subtle but diffuse ground-glass opacification of AIP in the acute exudative phase.* ***(Right)*** *Axial HRCT shows diffuse symmetric ground-glass opacification in AIP. Bilateral small volume pleural effusions.*

Desquamative Interstitial Pneumonia (1)

Key Facts

Terminology
- Chronic idiopathic interstitial pneumonia characterized by macrophage filling of alveolar spaces, probably related to cigarette smoking
- Term "desquamative" is a misnomer: Cells filling alveoli initially thought to represent desquamated alveolar lining cells

Imaging Findings
- Best diagnostic clue: Smoker with HRCT showing diffuse ground-glass opacities
- Variable and nonspecific appearance
- Ground-glass pattern (80%)
- Lower lung zones predominance 70%
- Peripheral predominance 60%
- Reticular pattern (60%)
- Small well-defined cysts

Top Differential Diagnoses
- RB-ILD
- Cryptogenic Organizing Pneumonia (COP)
- Drug Reaction
- Hypersensitivity Pneumonitis
- Nonspecific Interstitial Pneumonia
- Lymphoid Interstitial Pneumonia
- Sarcoidosis

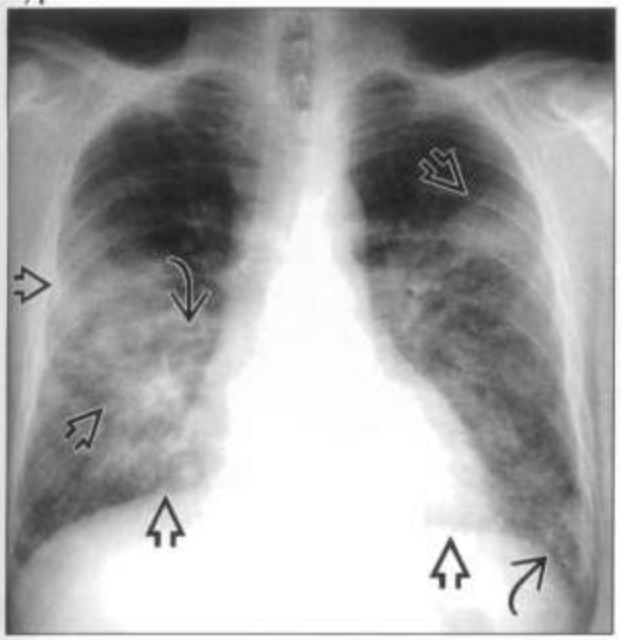
Pathology
- Association with smoking, 90%
- Concept that DIP evolves to UIP now discredited
- Intraalveolar space and alveolar duct accumulation of pigmented macrophages

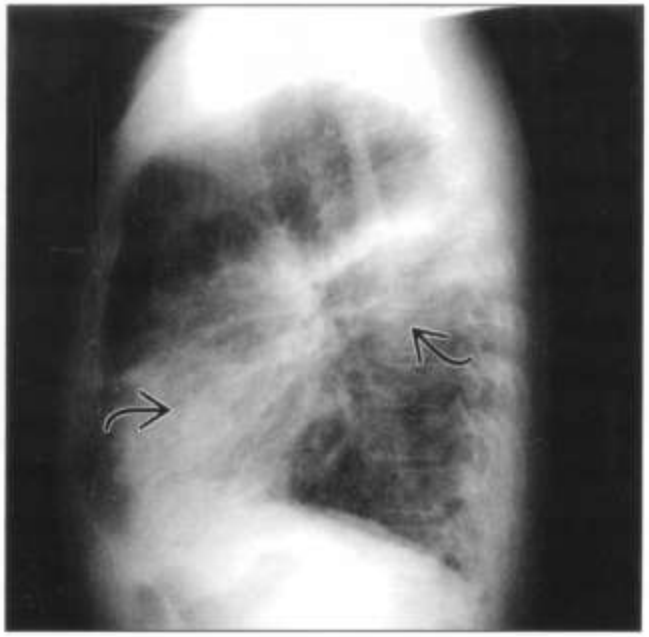
Clinical Issues
- Insidious onset dyspnea, dry cough

Desquamative Interstitial Pneumonia (2)

Image Gallery

Typical





(Left) *Frontal radiograph in a smoker shows bilateral large foci of vague "ground-glass" opacification (open arrows) in a patient with biopsy proven DIP. Curved arrows show linear reticular shadowing.* ***(Right)*** *Lateral radiograph in same patient shows to better advantage the linear/reticular opacities (curved arrows) in this patient with DIP.*

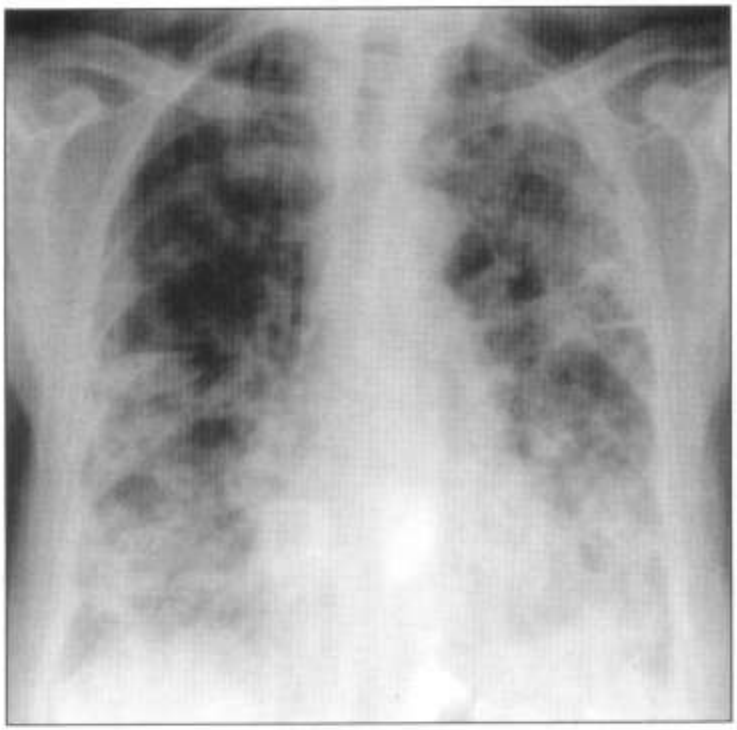
Idiopathetic pulmonary fibrosis

- **Cryptogenic fibrosing alveolitis**
- **Usual interstitial pneumonia**
- **Chronic interstitial pulmonary fibrosis**

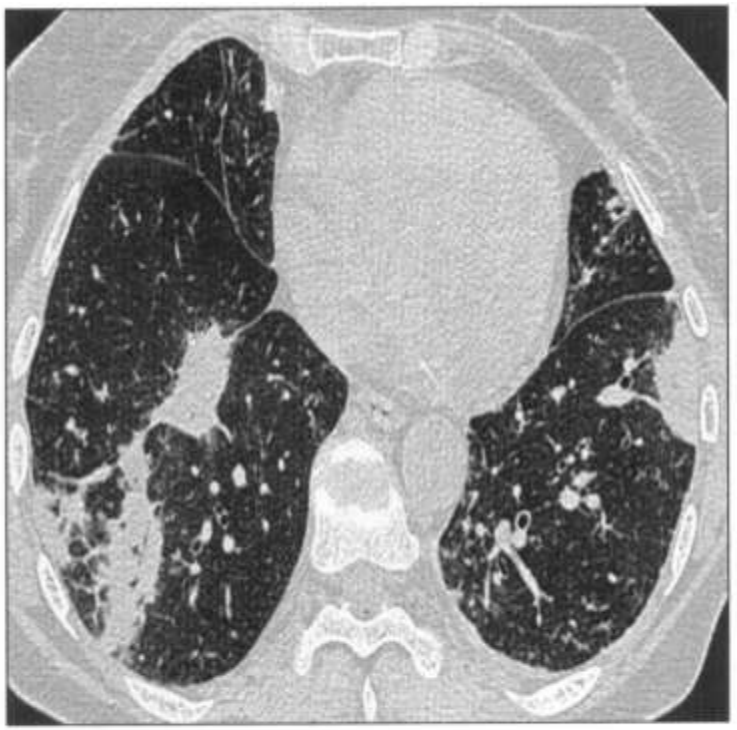
Acute interstitial pneumonia

- **Diffuse alveolar damage**

Cryptogenic Organizing Pneumonia (1)



Radiograph showing diffuse but predominantly mid- and lower zone air space opacities in a patient with cryptogenic organizing pneumonia.



Axial HRCT shows typical bilateral patchy areas of consolidation in the lower lobes in a patient with cryptogenic organizing pneumonia.

Cryptogenic Organizing Pneumonia (2)

Key Facts

Terminology
- Clinicopathological entity characterized by polypoid plugs of loose granulation tissue within air spaces

Imaging Findings
- Bilateral areas of consolidation ± ground-glass opacification
- Opacities may be migratory
- May be unilateral in minority
- Usually patchy distribution but may be subpleural
- Preserved lung volumes

Top Differential Diagnoses
- Lymphoma
- Bronchioloalveolar Cell Carcinoma (BAC)
- Chronic Eosinophilic Pneumonia
- Lung Cancer (Solitary Mass)
- Aspiration
- Lipoid Pneumonia
- Pulmonary Embolism

Pathology
- Need to exclude other causes of an organizing pneumonia pattern

Clinical Issues
- Symptoms generally develop over a period of few weeks
- Response to steroids generally striking

Diagnostic Checklist
- COP effectively a diagnosis of exclusion and other potential causes of chronic multifocal air space opacification need to be considered

Viral Pneumonia (1)

Key Facts

Imaging Findings

- Best diagnostic clue: Diffuse interstitial thickening in febrile patient
- Variable and overlapping appearance
- Atelectasis: Segmental/subsegmental; lobar atelectasis, especially in children
- Bacterial superinfection: Lobar/multilobar consolidation, cavitation, pleural effusion
- Ground-glass, airspace, interstitial opacities and/or centrilobular nodules
- Centrilobular nodules: Varicella-zoster, CMV and influenza
- Chest radiography: Usually sufficient for documenting pattern, extent of disease and to monitor therapy
- CT/HRCT: More sensitive, important in immunocompromised patients to document disease and begin early treatment

Top Differential Diagnoses

- Edema
- Hemorrhage
- Aspiration

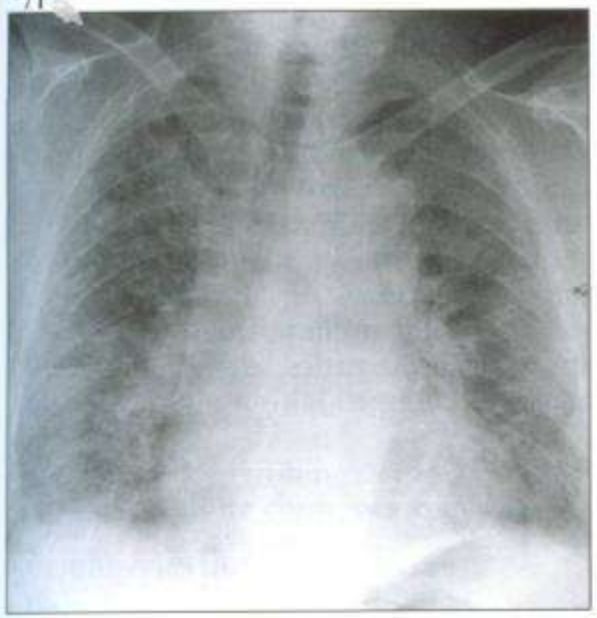
Pathology

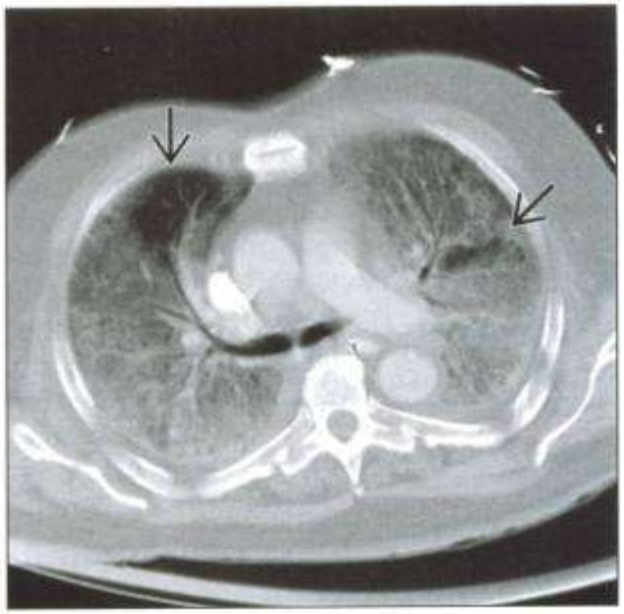
- Influenza A and B most common viral pneumonia in healthy adults
- Respiratory syncytial virus, most common in infants and children < age 4
- Higher prevalence of influenza, varicella-zoster, measles in pregnancy

Viral Pneumonia (2)

Image Gallery

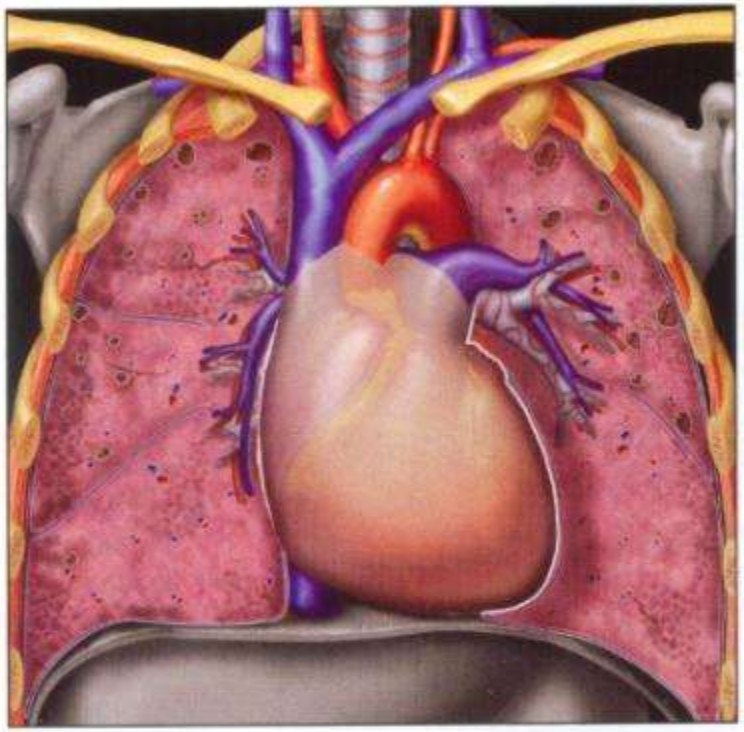
Typical



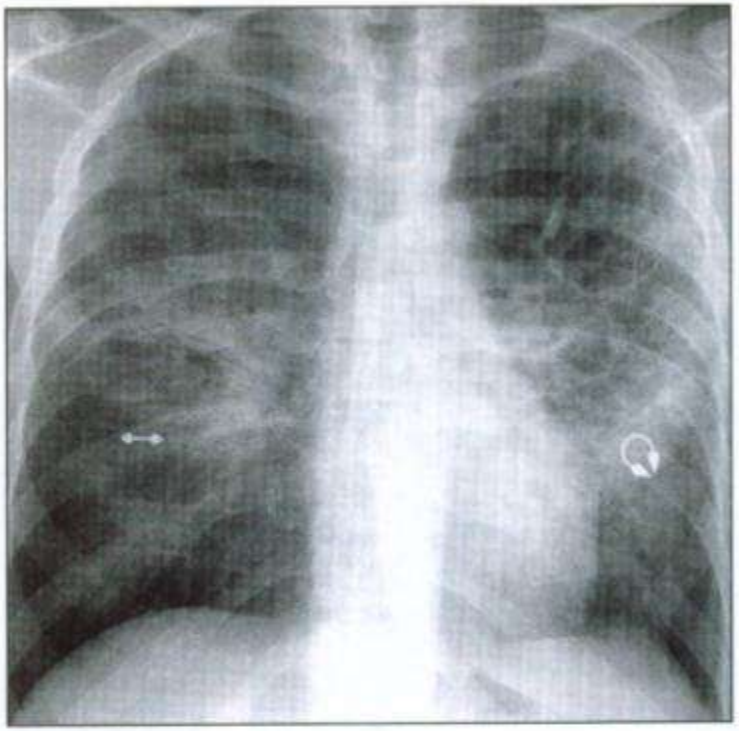


(Left) *Frontal radiograph in an elderly male shows diffuse bilateral hazy opacities. The heart size is slightly enlarged. He presented with dyspnea and confusion.* ***(Right)*** *Axial CECT shows diffuse ground-glass opacities and few septal lines. Geographic sparing seen at anterior segment of right upper and left upper lobes (arrows). Dx: Fulminant viral pneumonia*

Pneumocystis Pneumonia(1)



Pneumocystis pneumonia often presents with perihilar or diffuse ground-glass opacities. Upper lobe cysts may be seen in patients with AIDS.



Frontal radiograph in a 35 year old male with fever and dyspnea. A predominantly upper and mid lung ground-glass opacities with concurrent large cysts. Pneumocystis was isolated on sputum.

Pneumocystis Pneumonia(2)

Key Facts

Terminology

- Opportunistic fungal infection often affecting individuals with T-cell immunodeficiency

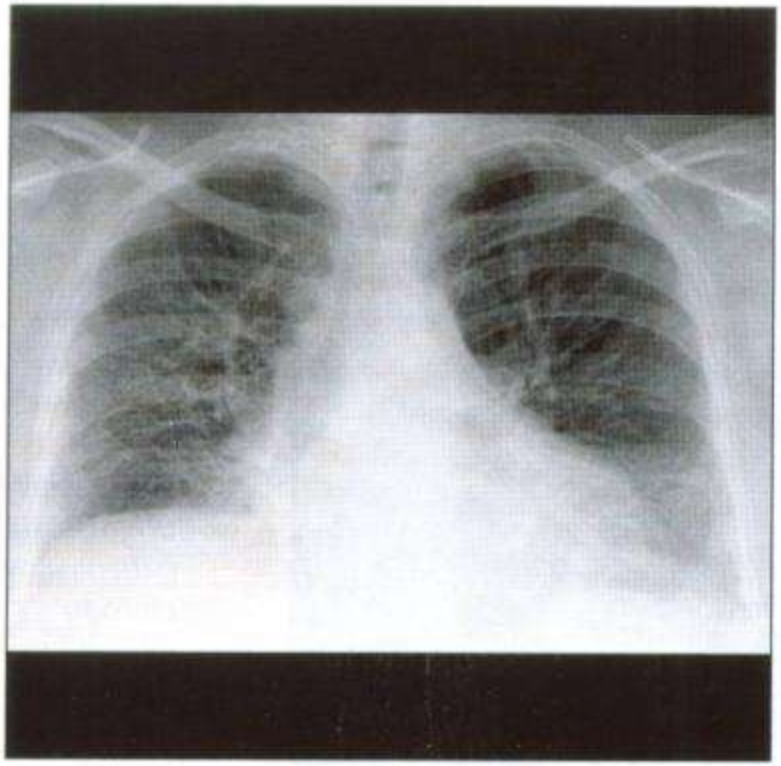
Imaging Findings

- Most common manifestation: Ground-glass opacities that are perihilar or diffuse
- If untreated, evolves into a consolidative appearance
- Concurrent upper lobe cysts, usually located in the periphery in 30% of AIDS patients

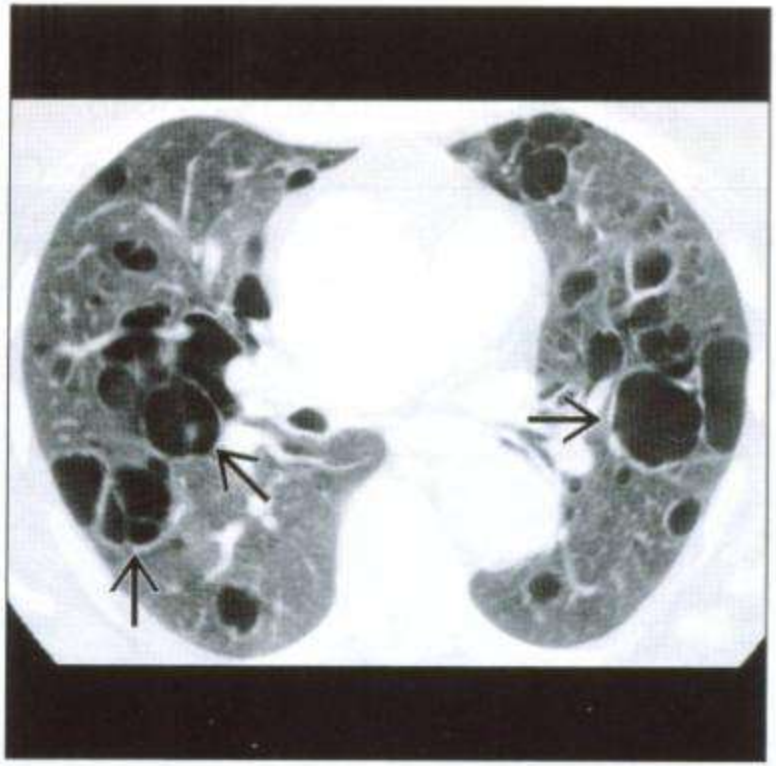
Clinical Issues

- Presentation variable with a significant difference between patients with and without AIDS
- Presenting symptoms: Non-productive cough, fever and hypoxia
- AIDS patients: Symptoms often subacute, with a prodrome of malaise, fever and dyspnea gradually worsening over 2-6 weeks
- Non-HIV patients: Symptoms often more rapid, usually presenting over 4-10 days
- Hypoxia on room air very common and important clinical feature, especially seen during minimal exercise
- Patients with PCP at risk for other immunosuppressed-related infections or neoplasms
- Commonly some worsening of the radiograph during the early course of therapy since these medications require tremendous amount of IV fluid for administration

Lymphocytic Interstitial Pneumonia (1)



Frontal radiograph shows nonspecific mild diffuse interstitial thickening in patient with Sjögren syndrome secondary to lymphocytic interstitial pneumonitis.



Axial HRCT shows multiple thin-walled cysts in Sjögren syndrome (arrows). Cysts vary in size with no lobar predilection. Lymphocytic interstitial pneumonitis.

Lymphocytic Interstitial Pneumonia (2)

Key Facts

Terminology
- Diffuse disease commonly referred to as LIP
- Focal disease commonly referred to as pseudolymphoma

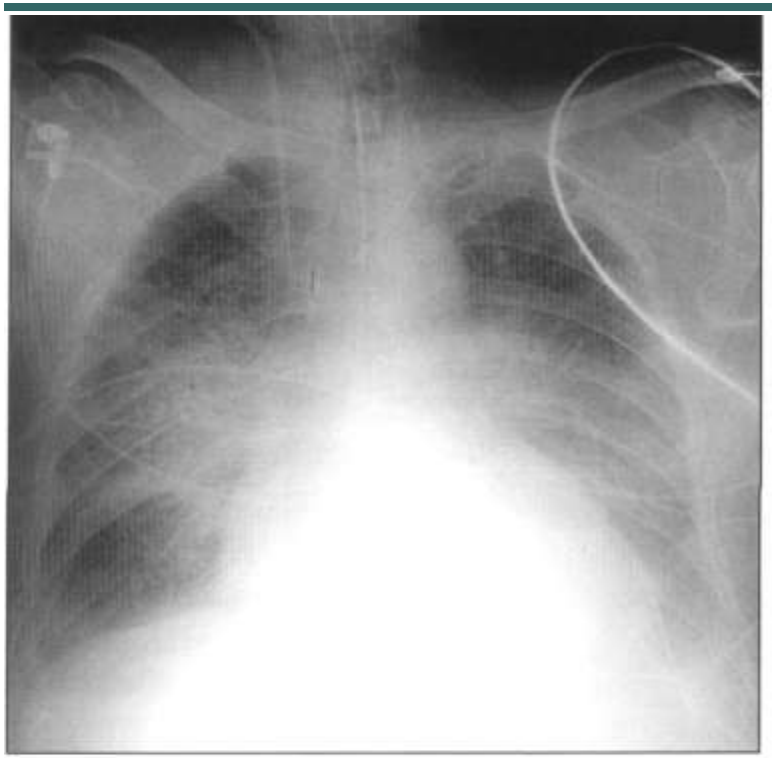
Imaging Findings
- Best diagnostic clue: Thin-walled cysts and centrilobular nodules
- Location: Basilar interstitial thickening in adult with Sjögren syndrome
- Morphology: BALT lymphomas have identical radiographic characteristics to non-neoplastic lymphoid lesions

Top Differential Diagnoses
- Nonspecific Interstitial Pneumonia (NSIP)
- Angioimmunoblastic Lymphadenopathy
- Castleman Disease
- Lymphomatoid Granulomatosis
- Hypersensitivity Pneumonitis

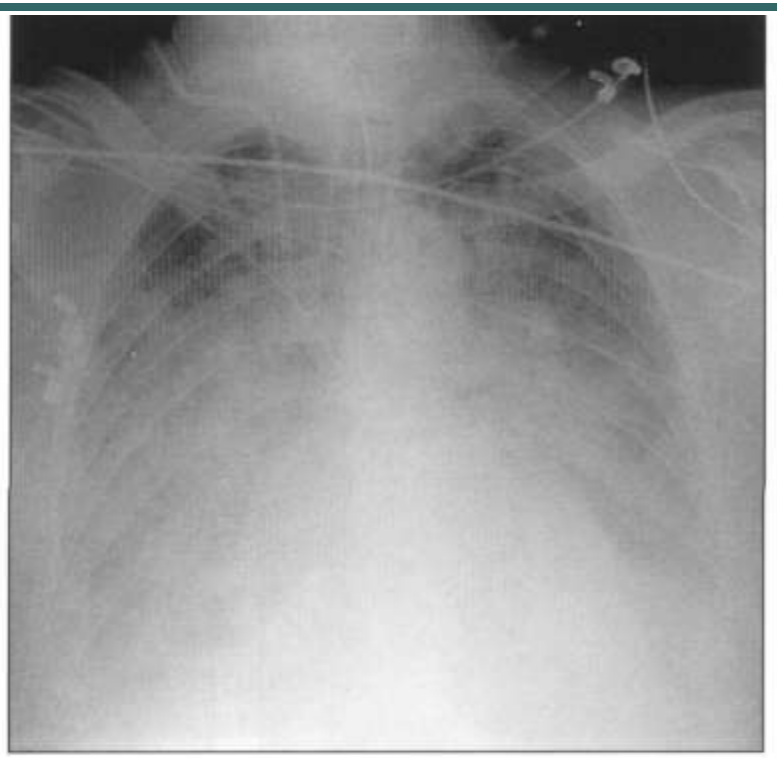
Pathology
- Pseudolymphoma and LIP identical histologically
- Small lymphocytes and plasma cells
- When centered on small airways: Follicular bronchiolitis
- When more florid into alveolar septa: LIP

Clinical Issues
- Dysproteinemia
- Gender: Adults: Women primarily
- May evolve into B-cell lymphoma, especially in Sjögren (5%)

Cardiogenic Pulmonary Edema (1)



Frontal radiograph demonstrates bilateral perihilar alveolar edema, pulmonary venous hypertension, small bilateral pleural effusions & cardiomegaly in patient with congestive heart failure.



Frontal radiograph of same patient only 4 hours later shows increase of bilateral pleural effusions & rapid progression of confluent alveolar disease from worsening cardiac pulmonary edema.

Cardiogenic Pulmonary Edema (2)

Key Facts

Terminology
- Increased fluid in extravascular compartment of lung from hemodynamic dysfunction

Imaging Findings
- Best diagnostic clue: Cardiomegaly, pulmonary venous hypertension (PVHTN) & pleural effusions
- Location: Worse in gravity dependent locations

Top Differential Diagnoses
- Pneumonia
- Lymphangitic carcinomatosis
- Non-cardiogenic edema
- Pulmonary hemorrhage
- Alveolar proteinosis
- Acute eosinophilic pneumonia

Pathology
- Imbalance in Starling forces
- Lungs: Reddish-blue, heavy, boggy & fluid-filled
- Edema, frequently bloody, can be squeezed from cut surfaces

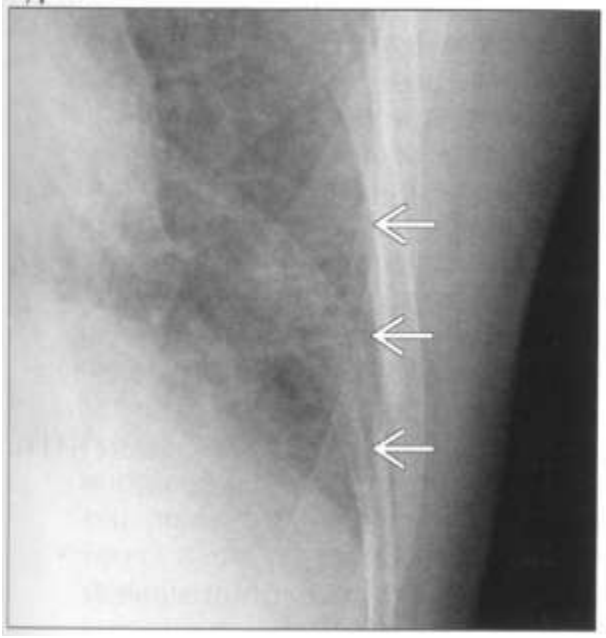
Clinical Issues
- Most common signs/symptoms: Paroxysmal nocturnal dyspnea, dyspnea on exertion, orthopnea
- Serum B-type natriuretic peptide: High positive & negative predictive value for CHF
- Standard treatment: Oxygen, diuretics, morphine, nitroglycerin, afterload reduction & inotropic agents

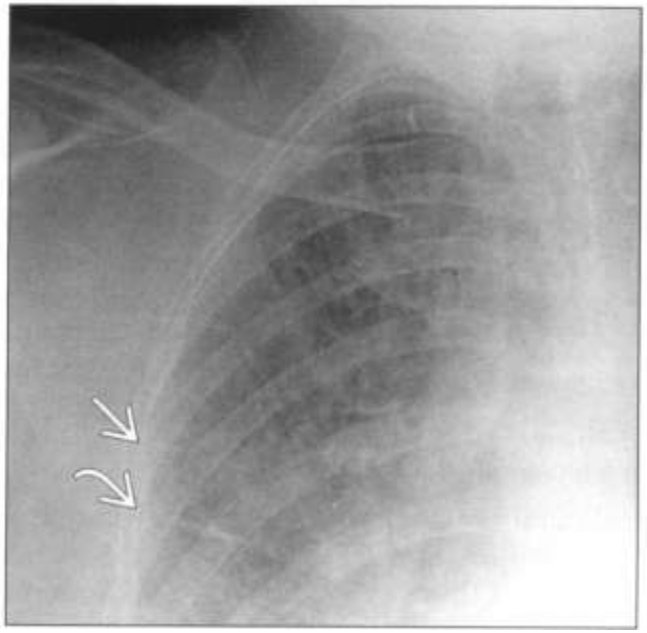
Diagnostic Checklist
- Appearance of cardiogenic pulmonary edema can be modified by noncardiogenic factors

Cardiogenic Pulmonary Edema (3)

Image Gallery

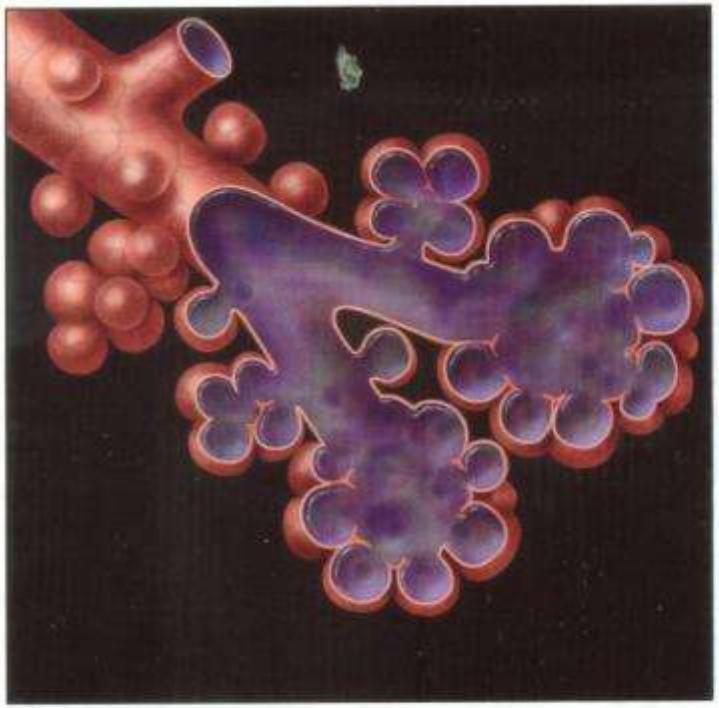
Typical



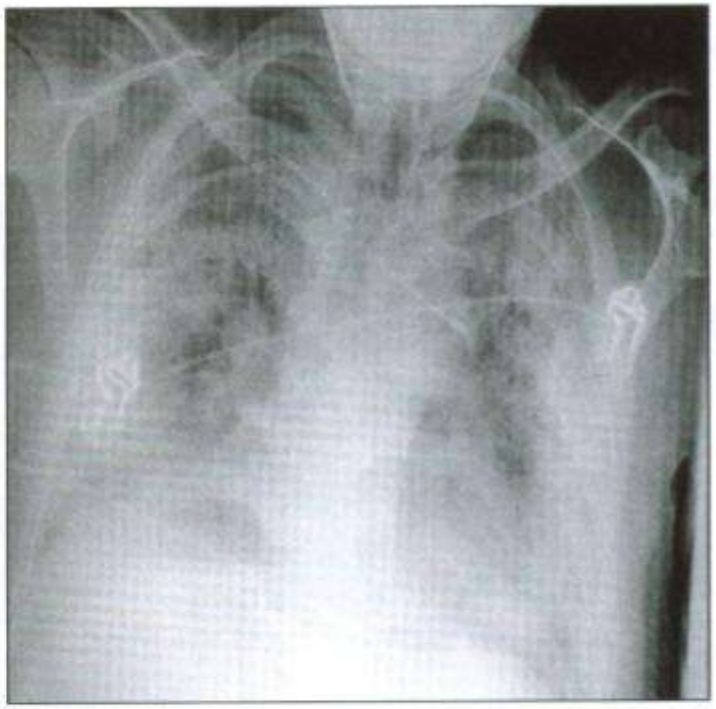


(Left) *Frontal radiograph in patient with congestive heart failure shows multiple horizontally oriented interlobular septal lines in left lung base, called Kerley B lines (arrows).* ***(Right)*** *Frontal radiograph in patient with congestive heart failure shows subpleural edema of minor fissure (curved arrow). Kerley A line is visible as thin white line with same orientation (arrow).*

Noncardiac Pulmonary Edema (1)



Graphic shows increased capillary permeability with proteinaceous hemorrhagic fluid filling alveoli in ARDS. Other features include hyaline membrane formation, alveolar atelectasis & small vessel microthrombosis.



Radiograph in a victim of a road traffic accident with ARDS. There is symmetric airspace opacification in both. The changes are most marked in the periphery of the lungs.

Noncardiac Pulmonary Edema (2)

Key Facts

Terminology
- Extravascular lung water due to increased permeability of the alveolar-capillary barrier

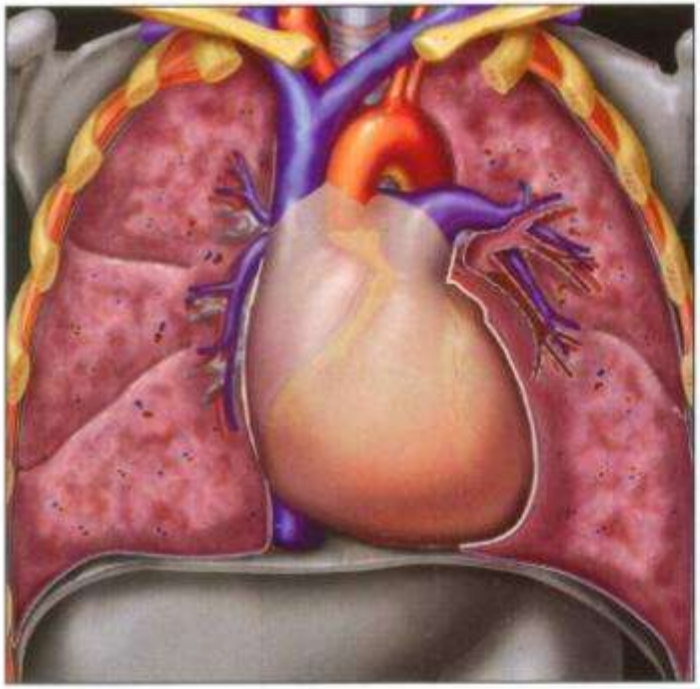
Imaging Findings
- Best diagnostic clue: Diffuse bilateral air space opacification on plain chest radiography and CT
- Favors the lung periphery
- Septal (Kerley B) lines less common than in cardiogenic edema
- Acute respiratory distress syndrome (ARDS) best "model" for noncardiac pulmonary edema
- In secondary (extrapulmonary) ARDS, roughly symmetric ("typical") changes seen more often than in primary (pulmonary ARDS)

Top Differential Diagnoses
- Cardiogenic Edema
- Diffuse Pulmonary Hemorrhage
- Widespread (Opportunistic) Pulmonary Infection

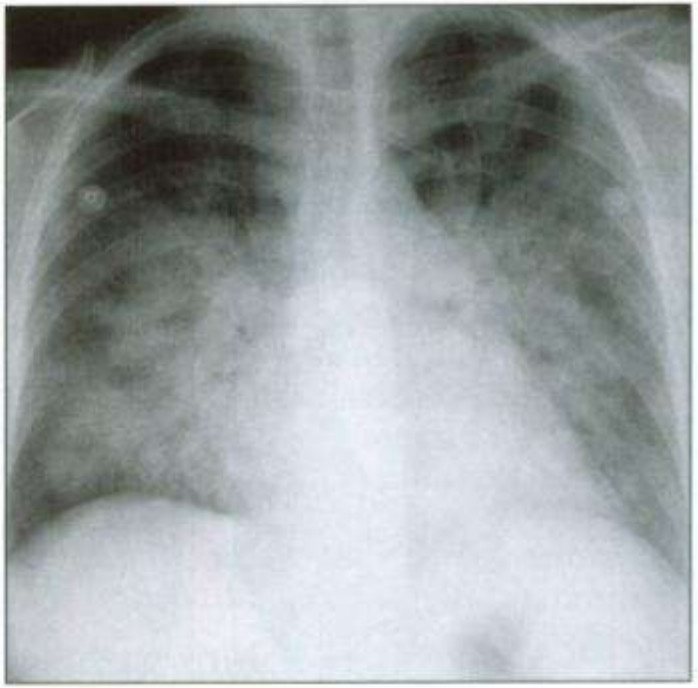
Pathology
- Increased alveolar-capillary permeability; inflammatory mediators damage capillary membrane
- Exudative
- Proliferative
- Chronic

Clinical Issues
- Onset of symptoms/signs may be insidious (over a few days) or relatively rapid (over a few hours) after an inciting pulmonary or extrapulmonary "event"

Goodpasture Syndrome (1)



Diffuse consolidation with relative sparing of the periphery and costophrenic angles is characteristic of Goodpasture syndrome.



Frontal radiograph in a 22 year old male with acute hemoptysis and hematuria, who had a viral illness 5 weeks ago. Renal biopsy demonstrated IgG glomeruli deposition (Goodpasture syndrome/ABMABD).

Goodpasture Syndrome (2)

Key Facts

Terminology
- Antibasement membrane antibody disease (ABMABD)
- Combination of circulating antiglomerular basement membrane antibodies, glomerulonephritis and DAH termed ABMABD
- Most use Goodpasture syndrome to describe both DAH and glomerulonephritis

Imaging Findings
- Best diagnostic clue: Acute diffuse ground-glass and consolidation in a young adult patient with hemoptysis and evidence of renal disease
- Radiographic findings vary depending on length of disease and the number of hemorrhagic episodes
- Lung periphery and costophrenic angles are usually spared
- Involvement of the periphery or costophrenic angles should suggest another diagnosis
- Late: Asymmetric pulmonary fibrosis, reticular opacities and traction bronchiectasis

Clinical Issues
- Acute shortness of breath, cough with mild hemoptysis and anemia
- Hemoptysis reported in 80-95%
- Recurrent episodes of pulmonary hemorrhage common
- Untreated Goodpasture syndrome often has fulminant course leading to death
- Early therapy results in both renal and lung disease remission
- Combination of plasmapheresis and immunosuppressive therapy

Summary

- 肺部感染其X光特徵