

Mycoplasmal, Viral, and Rickettsial Pneumonias

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VIRUS AND MYCOPLASMA account for innumerable cases of pneumonia in the United States. Yet, whereas considerable discussion of bacterial pneumonias can be found in radiologic textbooks, little space is devoted to viruses. The purpose of this article is to review the pertinent clinical and radiologic features of the more common viral and viral-like agents that produce pneumonia.

MYCOPLASMA PNEUMONIA

Of the variety of mycoplasma species, the smallest of free living organisms, only *M. pneumoniae* (Eaton agent) produces respiratory infections. These include pneumonia, tracheo-bronchitis, pharyngitis, and in 20% of cases, asymptomatic invasion. *M. pneumoniae* is one of a variety of organisms, including viruses, rickettsiae, and chlamydiae (psittacosis), that cause primary atypical pneumonia (PAP). In young adults, *M. pneumoniae* is estimated to cause approximately 50% of PAP. Its transmission is by the respiratory route with the organisms appearing in sputum or throat washings several days before the onset of clinical infection and persisting for several weeks thereafter. Naturally acquired immunity ensues. Localized outbreaks in military or school populations, among families, or in general communities in cyclical periods of 4–5 yr are described. Although occurring at any season, more cases are seen in the fall and early winter. Again, the younger age population appears more at risk, with attack rates, within families, of 70% for children and 20% for adults. These infections are not uncommon in patients with chronic pulmonary disease.¹⁷

Clinical Features

Clinically apparent pneumonia occurs in 3%–10% of infected persons (higher in families), and typically evolves insidiously, with fever, malaise, chills, frontal headache, anorexia, and nonproductive cough.⁷ Chest pain and hemoptysis are rare. Occasionally, the onset is dramatic, and the patient becomes critically ill and dyspneic. With pneumonia, the physical findings may include cyanosis, tachypnea, relative bradycardia, and

foci of rales. Signs of extensive pulmonary consolidation are rare. Occasionally, a modest pleural effusion occurs; rarely, a large effusion is found and may be bilateral.¹

These symptoms and signs may persist for 3–6 wk. The differential diagnosis includes viral and bacterial pneumonia. *M. pneumoniae* may cause diverse systemic involvement, including myringitis, (2%–8%), Guillain-Barre syndrome, myocarditis, pleuropericarditis, skin lesions, generalized lymphadenopathy, cold agglutinin-induced hemolytic anemia, aseptic meningitis, and Stevens-Johnson syndrome.

Laboratory studies are of limited usefulness. The WBC is generally normal, although values up to 20,000 cells/mm³ are reported. Hence, the WBC count cannot be relied upon in distinguishing mycoplasmal from bacterial pneumonia. Anemia and an elevated sedimentation rate may be encountered. Sputum smears and routine cultures are unrevealing. Since the organism lacks a cell wall, it does not take a Gram stain. For early diagnosis, the nonspecific serologic detection of cold hemagglutinins is employed. These titers begin to rise within 7 days and peak in 4 wk. A positive cold agglutinin test (1:64, or over) is seen in 60%–70% of patients; a false positive result (less than 1:64) may be seen in infectious mononucleosis, adenovirus infection, rubella, and influenza, among other conditions. Specific complement fixation antibody titers in paired acute and convalescent serum serve to confirm the diagnosis, but are not of initial diagnostic value.

Generally, the disease is of modest severity and is self-limiting, with complete recovery anticipated. Both tetracycline and erythromycin appear to accelerate radiographic and clinical improvement. Following a short course of anti-

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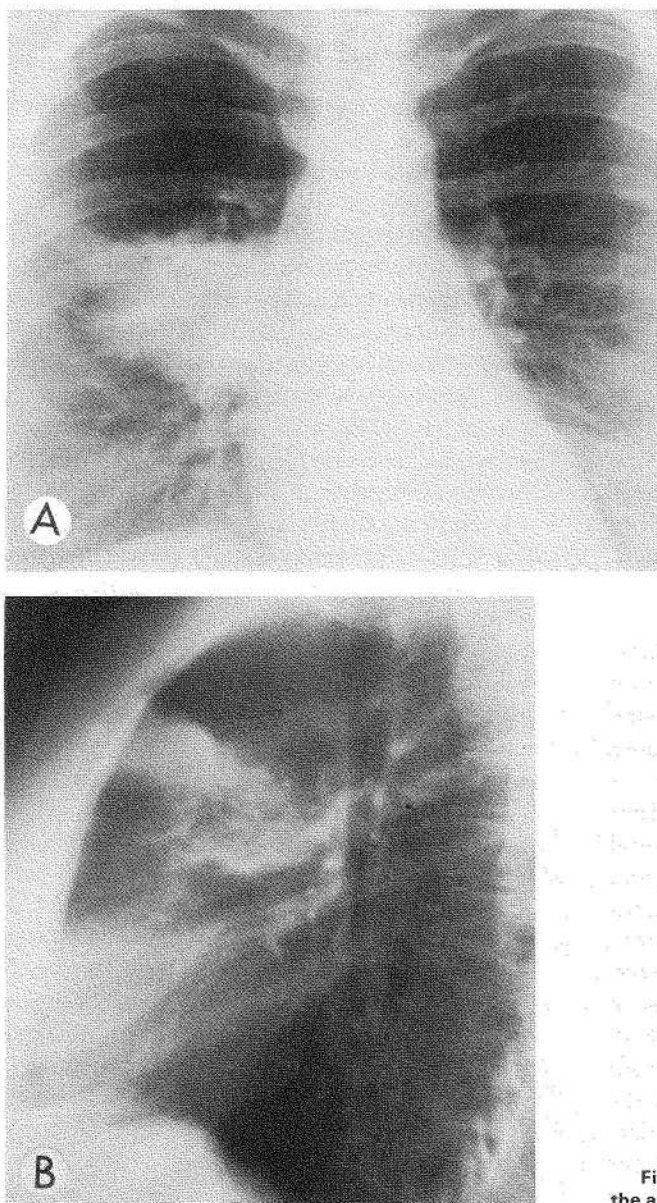


Fig. 1. *Mycoplasma pneumoniae*. Dense consolidation of the anterior segment of the right upper lobe.

biotic treatment, continued shedding of these organisms is reported.

Radiographic Findings

The most frequent appearance is that of a segmental area of dense consolidation (Fig. 1), although amorphous zones of patchy densities (Fig. 2) may rarely be seen.⁵ The infiltrates occur most often in the lower lung fields, but upper lobe involvement is not unusual. A less common presentation consists of a nonspecific

reticulonodular appearance, associated clinically with a more indolent chronic course.⁸ Pleural effusion is seen in up to 25% of cases, while hilar adenopathy is distinctly uncommon.

If therapy with erythromycin or tetracycline is not administered promptly, the infiltrates may slowly progress in extent (Fig. 3). With institution of the proper chemotherapy, the infiltrates may clear dramatically; it is not uncommon to have clearing within days (Fig. 4).

In summary, the roentgen appearance of



Fig. 2. *Mycoplasma pneumoniae*. Diffuse patchy infiltration in the right lower lobe.

mycoplasma pneumoniae is nonspecific, and includes a variety of patterns. It is only in the presence of a rising or elevated cold agglutinin titer or by the rapid clearance following appropriate antibiotics that this diagnosis can be suggested.

VIRAL PNEUMONIA

Of the more than 150 viruses associated with respiratory illness, this section will deal with only the more common species leading to pneumonia. Although viral respiratory infection is commonplace, pneumonia is less of a problem. The major reservoir of human infection is man himself, although certain animals do act as a reservoir for variants of influenza A. Droplet transmission is the common mode of dissemination of the disease. Factors of host resistance, organism dose, and virulence, and lung or body defense mechanisms influence infectivity.

In general, the clinical manifestations from the variety of viruses that cause pneumonia are similar, with few differentiating features. A preceding upper respiratory illness or bronchitis, laryngitis, or even bronchiolitis, may or may not

be in evidence. Fever and tachypnea are invariable, while dyspnea and cyanosis will be influenced by the severity of pulmonic inflammation and the extent of underlying cardiopulmonary disease. A nonproductive or minimally productive cough is typical; a large volume of purulent sputum raises the suspicion of bacterial infection. Rales, focal or in multiple sites, are often but not invariably auscultated. The paucity of typical physical signs of pneumonia is surprising in light of the frequently advanced radiographic involvement. Pleural pain and signs of pleural effusion are not common. Travel history, contact with animals or ill patients, and clusters of illness in schools or place of occupation may provide added clues to the infectious organism.

As with the clinical manifestations, there is nothing particularly distinctive about the radiological features,¹¹ and all conceivable roentgen patterns may be found.² The most common appearance is one of air space consolidation, frequently very dense. At times, the consolidation will be localized to one segment, but diffuse involvement of both lungs may also be seen. Sometimes the pattern is diffusely acinar-nodular. Less commonly, a pattern consisting of lines or reticulonodular densities occur. Rarely, punctate calcific densities develop with healing.

In summary, there is no one characteristic appearance of viral pneumonia and any pattern is possible. Microabscesses, cavitation, and bulging fissures favor a bacterial over a viral etiology, but these findings are infrequent. It should be evident, then, that the distinction between viral and bacterial pneumonia is usually not possible solely on the roentgen appearance.¹⁵ However, clinical differentiation of bacterial and viral pneumonia is important for therapeutic reasons. The salient distinguishing features are summarized in Table 1.

Influenza Pneumonia

Of the viral pneumonias in adults, influenza is among the most common, partially due to its frequent epidemic patterns.³ The three most common presentations include primary influenza pneumonia; bacterial consolidation (*S. pneumoniae* or staphylococcus) following a typical influenza infection; or a concomitant influenzal and bacterial pneumonitis. The

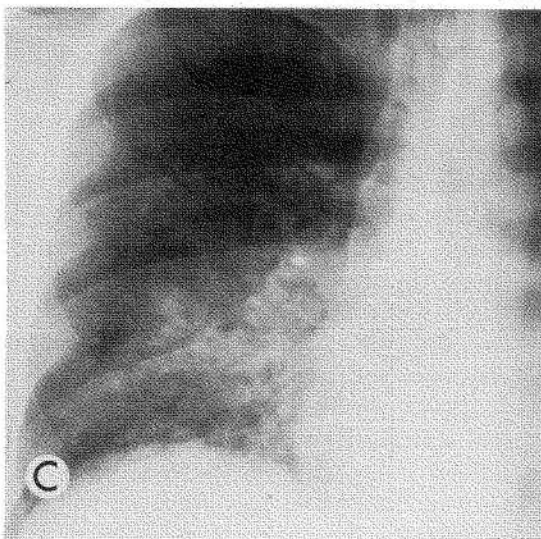
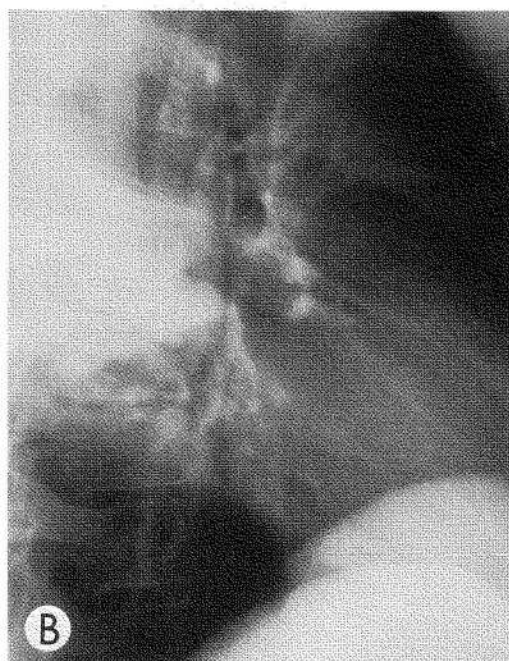
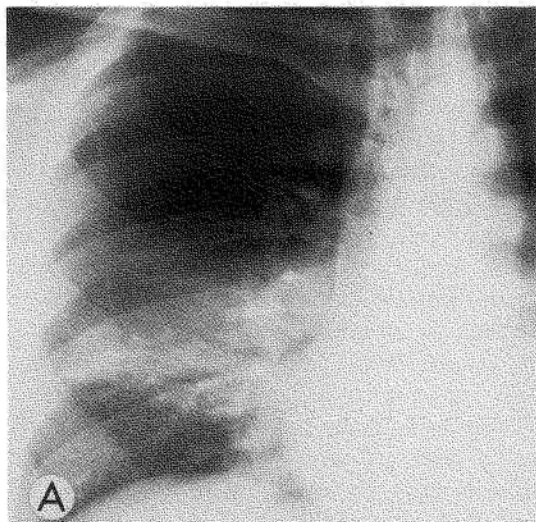


Fig. 3. *Mycoplasma pneumoniae*. This 25-yr-old white man presented with a 2-wk history of cough and malaise. (A,B) PA and lateral films of the chest reveal dense consolidation of the superior segment of the right lower lobe. The patient was placed on penicillin only to return in 1 wk with a temperature of 103°F and chills. A repeat film (C) demonstrated extension of the infiltrate, which now had a more amorphous patchy appearance. A film 3 days after erythromycin was begun showed dramatic improvement.

influenza virus is comprised of three species, *A*, *B*, and *C*, based upon constituent membrane protein and nucleocapsid antigens. It has been established that major antigenic shifts in these surface antigens occur at approximately 10-yr intervals and hence are responsible for new pandemics, such as those of 1918 and 1957. Prevention by immunization with influenza virus vaccine, if antigenically compatible, can lessen

the incidence of symptoms by 70% and should be instituted in the fall season for high risk patients.

For most patients, the disease follows a benign course following a typical respiratory illness. However, primary influenza pneumonia itself constitutes an acute and highly contagious infection with a high mortality rate. Serious sequelae arise from pulmonic extension, with or without

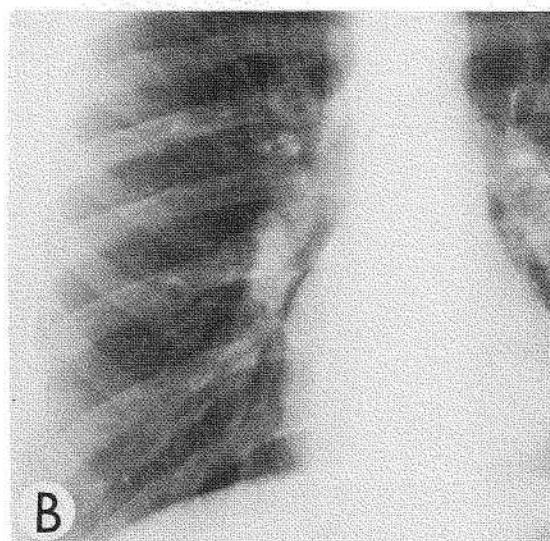
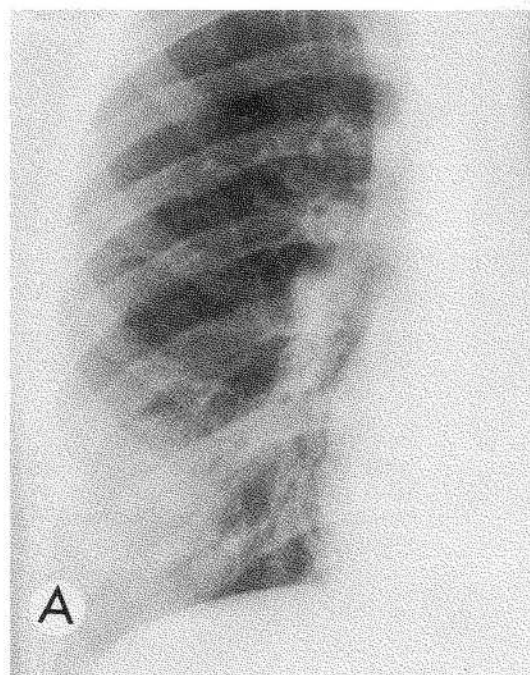


Fig. 4. *Mycoplasma pneumoniae*. (A) The amorphous infiltrate in the anterior basal segment of the right lower lobe cleared completely within 3 days after the institution of tetracycline therapy (B).

bacterial complications. Lethal risk factors include older age, preexisting cardiopulmonary disease, and late pregnancy, but death may occur in otherwise healthy adults. Toxic symptoms and physical findings are not specific, and

Table 1. Clinical Findings in Bacterial and Viral Pneumonias

	Viral	Bacterial
Epidemiology	Epidemic	Not relevant
Onset	Preceding URI; malaise; gradual development	Variable URI; constitutional symptoms; More acute onset
Type of cough	Nonproductive or scant (muroid)	Purulent sputum (bloody)
Pleural pain	Uncommon	Common
Chills	Uncommon	Common
Fever	Low to moderate grade	High
Tachycardia	Not striking	120/min
Physical examination of chest	Modest findings	Consolidation (dullness), egophony, rales
WBC	Normal, leucopenia, or mild leucocytosis	Polymorphonuclear leucocytosis
Pleural effusion	Rare	More common; empyema
Sputum smear	Polymorphonuclear	Polymorphonuclear and intracellular bacteria
Blood culture	Negative	May be positive
Serology	Useful	Not helpful
Response to antibiotics	None	Good

respiratory failure or even adult respiratory distress syndrome (ARDS) may supervene.

The radiographic appearance is nonspecific. Infiltrates may be localized or diffuse, unilateral or bilateral. Dense areas of consolidation may intermingle with diffuse acinar shadows (Fig. 5). In fatal cases, rapid spread in the lungs may be seen (Fig. 6).

The diagnosis of primary influenza pneumonia may be difficult save during an obvious epidemic. Viral isolation or antibody titers are of little therapeutic value. Therapy is essentially supportive unless specific bacteria are defined. Ventilatory support with positive end-expiratory pressure (PEEP) may be needed for ARDS. The new antiviral drug Amantadine is of chemoprophylactic value only if administered prior to exposure.

Adenovirus and Respiratory Syncytial Virus (RSV)

Although common respiratory tract offenders, these viruses only occasionally lead to pneumoni-

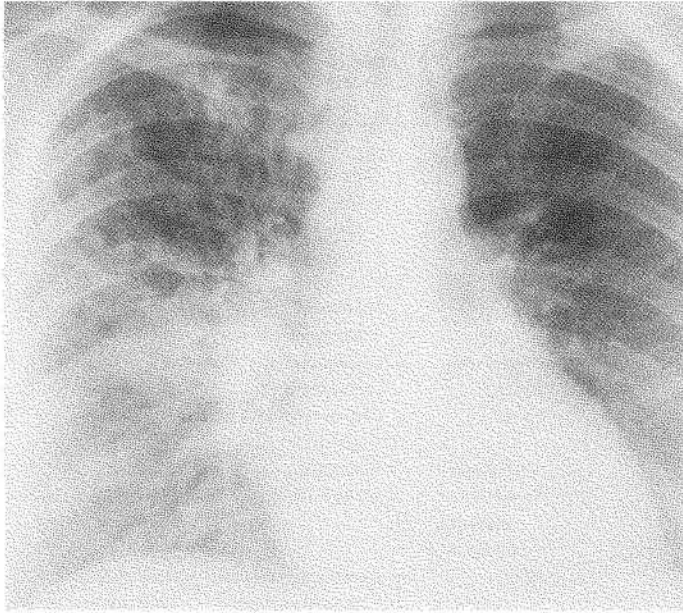


Fig. 5. Influenza pneumonia. Dense areas of consolidation and diffuse acinar shadows are seen throughout the entire right lung.

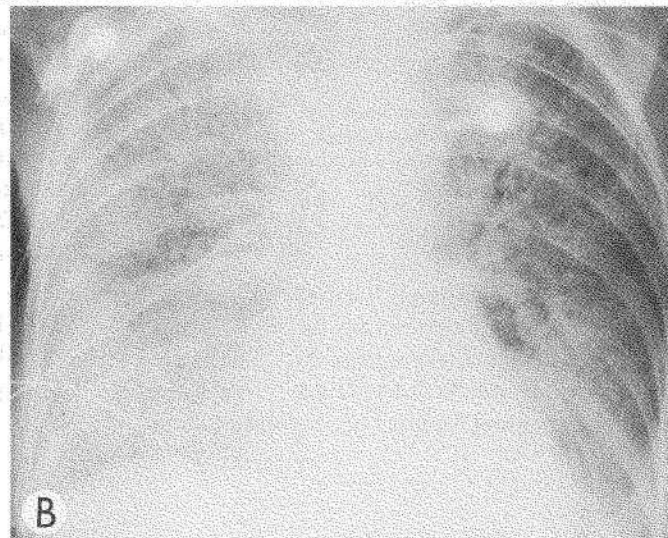
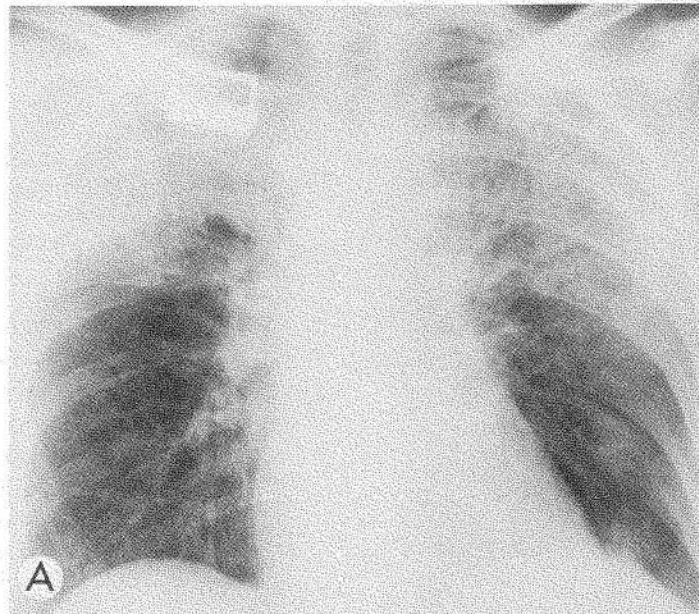


Fig. 6. Influenza pneumonia. This 25-yr-old female was on high doses of corticosteroids. (A) The initial infiltrate is most marked in the upper lobes. (B) Three days later the process is much more extensive. The patient died on the following day.

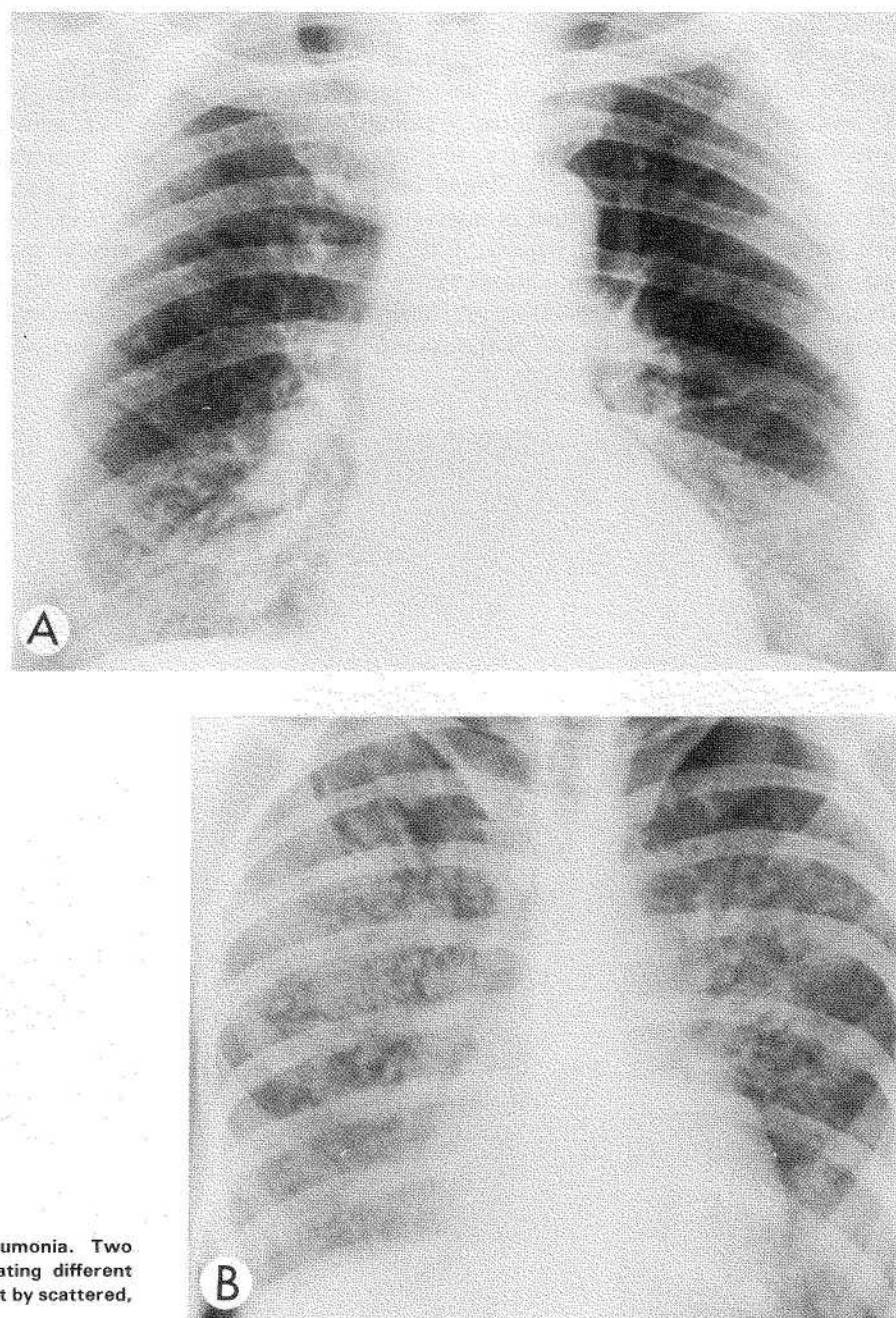


Fig. 7. Varicella pneumonia. Two different cases, demonstrating different degrees of lung involvement by scattered, patchy air-space densities.

tis. Adenovirus pneumonia generally involves young adults, with major outbreaks reported in military recruits.¹³ Coexisting pharyngitis, rhinitis, and conjunctivitis are common. RSV produces bronchiolitis during the first 6 mo of life, and pneumonia between the ages of 3 and 5 yr. No specific therapy is available for either virus, although a serologic diagnosis can be

made. Parainfluenza virus occasionally is responsible for pneumonia in children.

Varicella

Although the highly contagious exanthem chickenpox may occur at any age, the peak involvement is at 2–8 yr. In children, pneumonia is rare and then invariably bacterial in nature. In

adults, the disease is more severe with an estimated 10%–30% developing interstitial pneumonitis from the varicella-zoster virus. This generally evolves early in the clinical course. Women, particularly if pregnant, are prone to more severe pneumonitis.¹⁶ Hemoptysis, chest pain, and pleural effusion are described in association with severe dyspnea and tachypnea. Physical findings are sparse despite the clinical severity. Gram stain of sputum will reveal no organisms, but interestingly, a Giemsa stain of the sputum

may on occasion reveal cells with intranuclear inclusions.

The chest film usually shows patchy, diffuse air-space densities scattered throughout both lungs.¹⁰ Dense consolidation or segmental involvement is rare, and adenopathy and effusion are not seen (Fig. 7). Clearing may be slow, taking up to several months. Rarely, healing may leave multiple tiny punctate calcific densities scattered throughout both lungs.

Therapy is supportive. A recent preliminary

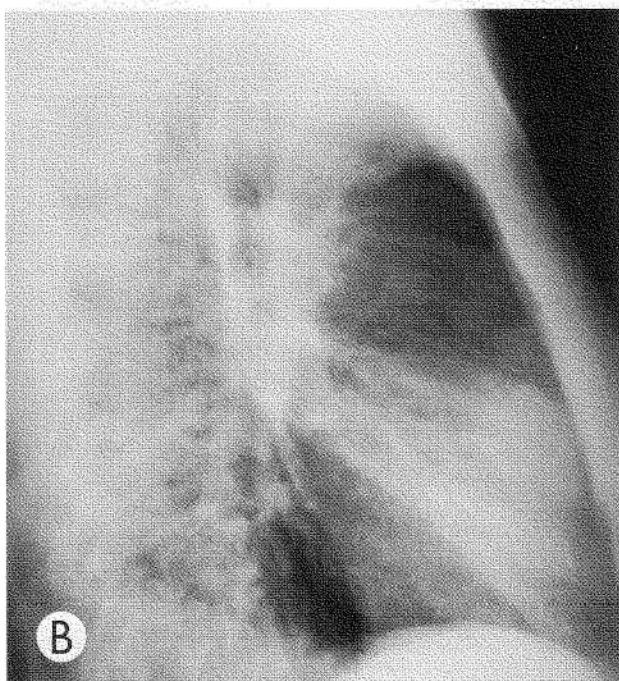
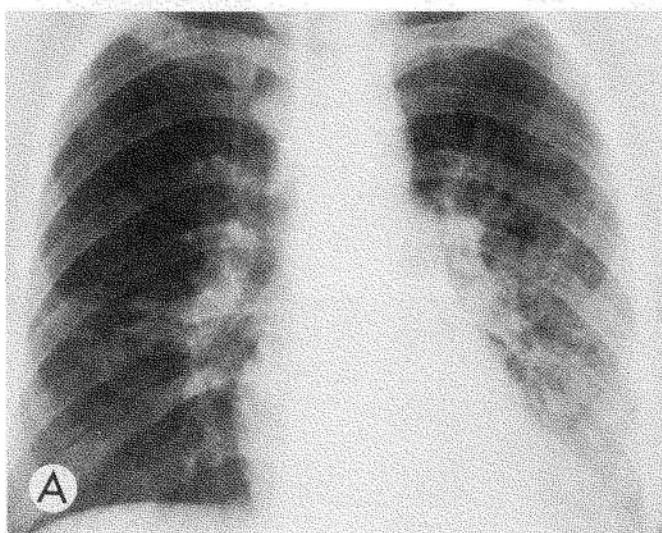


Fig. 8. Infectious mononucleosis. PA and lateral films demonstrate patchy areas of consolidation in the lingula, left lower lobe, and superior segment of the right lower lobe.

report suggests successful use of adenine arabinoside for treatment of chickenpox pneumonia.¹⁴

Rubeola (Measles)

Respiratory complications of measles include bronchitis, bronchiolitis, croup, and, rarely interstitial pneumonitis. Secondary bacterial invasion is a major concern. The measles virus is capable of inducing both degeneration and hyperplasia of the endothelial cells lining the bronchi and bronchioles. Inflammatory exudates consisting primarily of lymphocytes and plasma cells are also present. Within the respiratory epithelium giant cells may be found. Measles is the only cause of so-called giant cell pneumonia.

The roentgen appearance of this pathologic process manifests itself as a reticular pattern, sometimes associated with adenopathy.⁹ If superinfection with bacteria occurs, commonly streptococcus or staphylococcus, areas of segmental consolidation or foci of atelectasis will develop. Mediastinal emphysema is rare. Radiographic resolution may be slow, and takes several months.

Infectious Mononucleosis (EB Virus)

This systemic disease may rarely be complicated by pneumonitis or pleural effusion and even myopericarditis.⁶ Hilar adenopathy and a reticulonodular pattern may occasionally be seen. Less commonly, air-space disease may be present (Fig. 8). Atypical lymphocytosis with elevated titers of serum heterophile antibodies

are essentially diagnostic. Epstein-Barr virus antibody titers provide further diagnostic specificity.

Coxsackie A and B, Echo Viruses

Enterovirus infections, more common in summer months, may produce a viral pneumonia often characterized by nodular or soft infiltrates on the chest radiograph. Pleurodynia, herpangina, and myopericarditis are other rare manifestations. Coxsackie A₂₁ is not an uncommon cause of febrile respiratory illness in the military. Stool and upper respiratory tract cultures may isolate the organism. There is no specific therapy.

Cytomegalovirus (see page 63)

Chlamydia Infections

Psittacosis (ornithosis) is produced by obligate intracellular parasites that infect man from avian sources (pigeon, turkey, parrot, parakeet). Clinical history is instrumental in suspecting this infestation. Clinical manifestations are similar to those of viral infection, with an incubation period of 7–14 days followed by malaise, frontal headaches, fever, chills, and cough with little sputum. Physical findings in advanced pneumonic involvement are scant but may include tachypnea, dyspnea, sparse rales, and hypoxemia. Splenomegaly and meningoencephalitis may also occur.

Radiographic manifestations are varied (Fig. 9) and include the entire spectrum of pneumonic

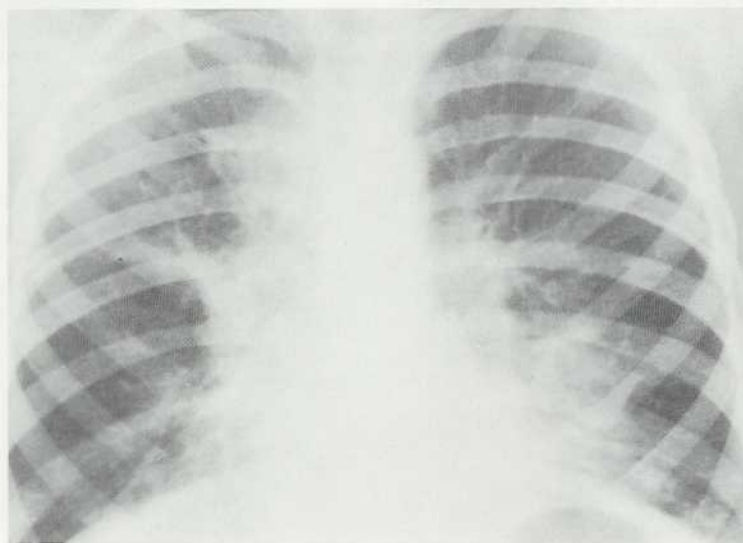


Fig. 9. Psittacosis pneumonia. This 3-yr-old boy developed cough and shaking chills with fever following the death of his pet parakeet. The clinical course was most suggestive of the disease, although not confirmed.

patterns.¹² Diagnosis is by serologic evidence of elevated complement fixing or other antibody titers, or by direct organism growth on special media. Tetracycline is indicated and appears to decrease the severity and duration of morbidity.

Rickettsia

Pulmonic involvement is a prominent feature of a variety of rickettsial infections, including Q fever, Rocky Mountain spotted fever, and epidemic and scrub typhus. Inhalation is the route of infection for Q fever, while ticks and mites inoculate both the spotted fever and scrub typhus virus by direct contact with the skin.⁴ While each rickettsial infection has its own

specific features, more often the differential diagnosis of viral, mycoplasmal, and clamydial infection is invoked. Q fever may yield a typical virus-like pneumonia with fatal cases exhibiting dense air-space consolidation. Diagnosis is initiated by epidemiologic or historical features and then confirmed by isolation of the specific rickettsia in biological fluids. However, culture is both tedious and hazardous. Hence, confirmation is best achieved by currently available serologic assays.

Radiographic findings are variable and include the entire spectrum of pneumonic presentations discussed previously. Full medical support and tetracycline or chloramphenicol are indicated.

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