

(>30 breaths/min) and tachycardia, hypotension in severe cases, and fever in most cases (although not in all elderly patients). Respiratory signs are varied, including dullness to percussion in areas of the chest with significant consolidation, crackles on auscultation, reduced expansion of the chest in some cases as a result of splinting to reduce pain, bronchial breathing in a minority of cases, pleural rub in occasional cases, and cyanosis in cases with significant hypoxemia. Among infants with severe pneumonia, chest wall indrawing and nasal flaring are common. Nonrespiratory findings can include upper abdominal pain if the diaphragmatic pleura is involved as well as mental status changes, particularly confusion in elderly patients.

DIFFERENTIAL DIAGNOSIS The differential diagnosis of pneumococcal pneumonia includes cardiac conditions such as myocardial infarction and heart failure with atypical pulmonary edema; pulmonary conditions such as atelectasis; and pneumonia caused by viral pathogens, mycoplasmas, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Legionella*, or (in HIV-infected and otherwise immunocompromised hosts) *Pneumocystis*. In cases with abdominal symptoms, the differential diagnosis includes cholecystitis, appendicitis, perforated peptic ulcer disease, and subphrenic abscesses. The challenge in cases with abdominal symptoms is to remember to include pneumococcal pneumonia—a nonabdominal process—in the differential diagnosis.

DIAGNOSIS Some authorities advocate treating uncomplicated, non-severe, community-acquired pneumonia without determining the microbiologic etiology, given that this information is unlikely to alter clinical management. However, efforts to identify the cause of pneumonia are important when the disease is more severe and when the diagnosis of pneumonia is not clearly established. The gold standard for etiologic diagnosis of pneumococcal pneumonia is pathologic examination of lung tissue. In lieu of that procedure, evidence of an infiltrate on chest radiography warrants a diagnosis of pneumonia. However, cases of pneumonia without radiographic evidence do occur. An infiltrate can be absent either early in the course of the illness or with dehydration; upon rehydration, an infiltrate usually appears. The radiographic appearance of pneumococcal pneumonia is varied; it classically consists of lobar or segmental consolidation (Fig. 171-6) but in some cases is patchy. More than one lobe is involved in ~30% of cases. Consolidation may be associated with a small pleural effusion

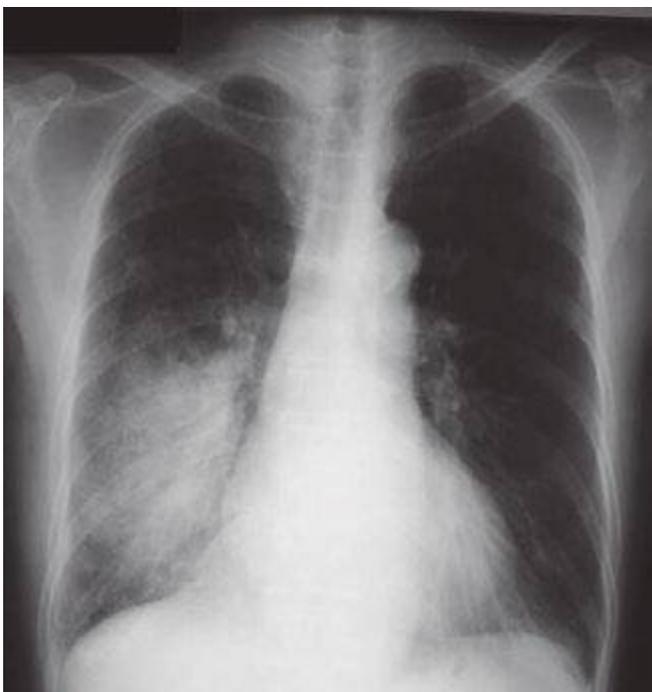


FIGURE 171-6 Chest radiograph depicting classic lobar pneumococcal pneumonia in the right lower lobe of an elderly patient's lung.

or empyema in complicated cases. In children, “round pneumonia,” a distinctly spherical consolidation on chest radiography, is associated with a pneumococcal etiology. Round pneumonia is uncommon in adults. *S. pneumoniae* is not the only cause of such lesions; other causes, especially cancer, should be considered.

Blood drawn from patients with suspected pneumococcal pneumonia can be used for supportive or definitive diagnostic tests. Blood cultures are positive for pneumococci in a minority (<30%) of cases of pneumococcal pneumonia. Nonspecific findings include an elevated polymorphonuclear leukocyte count (>15,000/ μ L in most cases and upward of 40,000/ μ L in some), leukopenia in <10% of cases (a poor prognostic sign associated with a fatal outcome), and elevated values in liver function tests (e.g., both conjugated and unconjugated hyperbilirubinemia). Anemia, low serum albumin levels, hyponatremia, and elevated serum creatinine levels are all found in ~20–30% of patients.

Urinary pneumococcal antigen assays have facilitated etiologic diagnosis. In adults, among whom the prevalence of pneumococcal nasopharyngeal colonization is relatively low, a positive pneumococcal urinary antigen test has a high predictive value. The same is not true for children, in whom a positive urinary antigen test can reflect the mere presence of *S. pneumoniae* in the nasopharynx.

Most cases of pneumococcal pneumonia are diagnosed by Gram's staining and culture of sputum. The utility of a sputum specimen is directly related to its quality and the patient's antibiotic treatment status.

COMPLICATIONS Empyema is the most common focal complication of pneumococcal pneumonia, occurring in <5% of cases. When fluid in the pleural space is accompanied by fever and leukocytosis (even low-grade) after 4–5 days of appropriate antibiotic treatment for pneumococcal pneumonia, empyema should be considered. Parapneumonic effusions are more common than empyema, representing a self-limited inflammatory response to pneumonia. Pleural fluid with frank pus, bacteria (detected by microscopic examination), or a pH of ≤ 7.1 indicates empyema and demands aggressive and complete drainage, usually through chest tube insertion.

Meningitis Pneumococcal meningitis typically presents as a pyogenic condition that is clinically indistinguishable from meningitis of other bacterial etiologies. Meningitis can be the primary presenting pneumococcal syndrome or a complication of other conditions such as skull fracture, otitis media, bacteremia, or mastoiditis. Now that *H. influenzae* type b vaccine is routinely used, *S. pneumoniae* and *Neisseria meningitidis* are the most common bacterial causes of meningitis in both adults and children. Pyogenic meningitis, including that due to *S. pneumoniae*, is associated clinically with findings that include severe, generalized, gradual-onset headache, fever, and nausea as well as specific CNS manifestations such as stiff neck, photophobia, seizures, and confusion. Clinical signs include a toxic appearance, altered consciousness, bradycardia, and hypertension indicative of increased intracranial pressure. A small proportion of adult patients have Kernig's or Brudzinski's sign or cranial nerve palsies (particularly of the third and sixth cranial nerves).

A definitive diagnosis of pneumococcal meningitis rests on the examination of CSF for (1) evidence of turbidity (visual inspection); (2) elevated protein level, elevated white blood cell count, and reduced glucose concentration (quantitative measurement); and (3) specific identification of the etiologic agent (culture, Gram's staining, antigen testing, or polymerase chain reaction [PCR]). A blood culture positive for *S. pneumoniae* in conjunction with clinical manifestations of meningitis also is considered confirmatory. Among adults, detection of pneumococcal antigen in urine is considered highly specific because of the low prevalence of nasopharyngeal colonization in this age group.

The mortality rate for pneumococcal meningitis is ~20%. In addition, up to 50% of survivors experience acute or chronic complications, including deafness, hydrocephalus, and mental retardation in children and diffuse brain swelling, subarachnoid bleeding, hydrocephalus, cerebrovascular complications, and hearing loss in adults.

Other Invasive Syndromes *S. pneumoniae* can cause other invasive syndromes involving virtually any body site. These syndromes include