



more frequently colonized with *S. aureus*, including methicillin-resistant strains, and gram-negative bacilli, including *Pseudomonas aeruginosa*. When a hospitalized patient aspirates his or her oropharyngeal flora, it may contain one of these organisms. Microorganisms that almost never cause pneumonia include *Candida* species and enterococci.

For a deeper discussion of these topics, please see Chapter 9, "Overview of Pneumonia," in Goldman-Cecil Medicine, 25th Edition.

CLINICAL PRESENTATION

Patients with pneumonia usually have an acute onset of fever, chills, cough, sputum production, dyspnea, and sometimes pleuritic chest pain. Patients may produce blood-tinged sputum that appears rust colored, a classic sign of pneumonia due to *S. pneumoniae*. Extrapulmonary signs and symptoms may include nausea, vomiting, diarrhea, abdominal pain, headache, confusion, arthralgia, myalgias, and change in mental status. Signs and symptoms can be blunted or absent in the elderly. Rales or rhonchi may be heard on auscultation of the chest. A leukocytosis with a left shift (i.e., increased band forms), pulmonary signs and symptoms, and a new infiltrate seen on the chest radiograph are used to diagnose pneumonia.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

When pneumonia is suspected, the next step is to determine the etiologic diagnosis. Unfortunately, there is no single diagnostic

test with a high sensitivity and high specificity. The sputum Gram stain provides useful diagnostic information. Although epithelial cells from the upper respiratory tract and oropharyngeal flora may contaminate an expectorated sputum sample, careful examination of the sputum Gram stain can reveal an area of the specimen that originated from the lower respiratory tract and contains neutrophils, and examination for bacteria in that area can be helpful. However, some patients do not produce sputum, and prior antibiotic use can alter sputum results.

S. pneumoniae is a gram-positive coccus that forms pairs and chains; the cocci are sometimes pointed at one end (i.e., lancet shaped). *H. influenzae* is a pleomorphic gram-negative rod. *S. aureus* is a gram-positive coccus that forms "grape-like" clusters. *M. catarrhalis* is gram-negative diplococcus. These distinct morphologic features allow a presumptive diagnosis of a specific etiologic agent when seen on a Gram stain of sputum (Fig. 92-2).

Mycoplasma, *Legionella*, *Mycobacterium*, and *Chlamydia* species are not seen on the sputum Gram stain. *Mycobacteria* are seen with special acid-fast staining.

Culture of sputum can reveal the etiologic diagnosis, and results should be correlated with findings from the sputum Gram stain. However, pneumococci are fastidious. A study of patients with bacteremic pneumococcal pneumonia found that only 55% of sputum cultures grew pneumococci. *Mycoplasma* species, *Legionella* species, *Mycobacterium* species, and *C. pneumoniae* do not grow on routine agar. Special culture media are required for certain bacteria, such as Löwenstein-Jensen medium for

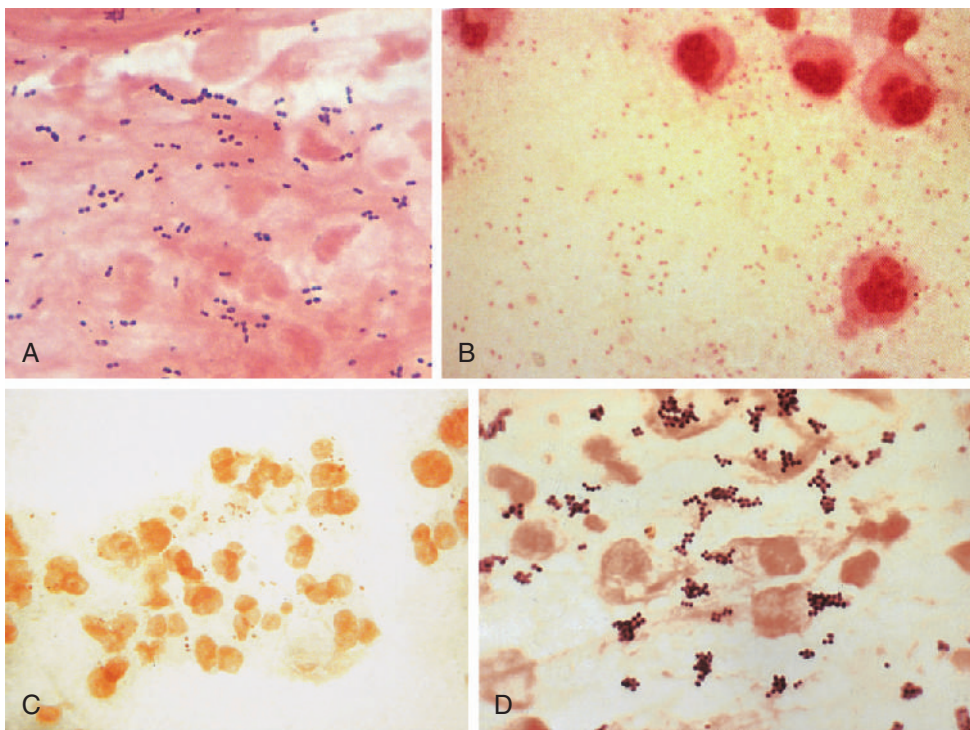


FIGURE 92-2 Sputum Gram stain. **A**, *Streptococcus pneumoniae*. **B**, *Haemophilus influenzae*. **C**, *Moraxella catarrhalis*. **D**, *Staphylococcus aureus*. PCV7, 7-Valent pneumococcal conjugate vaccine. (**A**, From Murray PR: Medical microbiology, ed 7, Philadelphia, 2013, Elsevier; **B**, From de la Maza LM, Pezzlo MT, Shigei JT, Peterson EM: Color atlas of medical bacteriology, Washington, D.C. 2004, ASM Press; **C**, From Ferri F: Ferri's color atlas and text of clinical medicine, Philadelphia, 2009, Elsevier; **D**, From Donowitz GR: Acute pneumonia. In Mandell GL, Bennett JE, Dolin R, editors: Mandell, Douglas, and Bennett's principles and practice of infectious diseases, ed 8, Philadelphia, 2015, Churchill Livingstone.)