Lower Respiratory Infections: Bronchitis and Pneumonia

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1 Bronchitis

1.1 Definition

Acute bronchitis is defined as a self-limiting lower respiratory tract infection, to distinguish this condition from common colds and other upper respiratory ailments. Bronchitis refers specifically to infections causing inflammation in the bronchial airways, whereas pneumonia denotes infection in the lung parenchyma resulting in consolidation of the affected segment or lobe.

Although there is no universally accepted definition for acute bronchitis, cough as the predominant symptom, with sputum production, wheezing, or chest pain.

Bronchitis and bronchiolitis involve inflammation of the bronchial tree. Bronchitis is usually preceded by an upper respiratory tract infection or forms part of a clinical syndrome in diseases such as influenza, pertussis, scarlet fever and typhoid fever. Either bacteria or virus can be the causative pathogens. Bronchiolitis is a viral respiratory disease of infants and is caused primarily by respiratory syncytial virus. Other viruses, including parainfluenza viruses, influenza viruses and adenoviruses are also known to cause bronchiolitis.

1.2 Pathogenesis

When the bronchial tree is infected, the mucosa becomes hyperemic and edematous and produces copious bronchial secretions. The damage to the mucosa can range from simple loss of mucociliary function to actual destruction of the respiratory epithelium, depending on the organisms(s) involved. Patients with chronic bronchitis have an increase in the number of mucus-producing cells in their airways, as well as inflammation and loss of bronchial epithelium, Infants with bronchiolitis initially have inflammation and sometimes necrosis of the respiratory epithelium, with eventual sloughing. Bronchial and bronchiolar walls are thickened. Exudate made up of necrotic material and respiratory secretions and the narrowing of the bronchial lumen lead to airway obstruction. Areas of air trapping and atelectasis develop and may eventually contribute to respiratory failure.

1.3 Microbiologic Diagnosis

Sputum specimens are cultured for bacteria, fungi and viruses. Culture of nasal washings is usually sufficient in infants with bronchiolitis. Other methods (fluorescent staining, blood cultures and/or serologic methods, enzyme-linked immunoassay methods) are less common.

1.4 Treatment

Symptomatic treatment, but if bacterial infection is suspected, bronchitis can be treated with antibacterials.

2 Pneumonia

2.1 Overview

Pneumonia is inflammation of the lungs with **consolidation** or interstitial **lung infiltrates**, most often categorised according to the causative organism. Typical symptoms might include fever, cough, dyspnoea, and chest pain. Because each specific type of pneumonia may result from a different aetiology and pathogenic mechanism, each subtype also has its characteristic risk factors, signs, and symptoms.

2.2 Definition

Pneumonia is an inflammation of the lung parenchyma. Consolidation of the lung tissue may be identified by physical examination and chest x-ray. From an anatomical point of view, lobar pneumonia denotes an alveolar process involving an entire lobe of the lung while bronchopneumonia describes an alveolar process occurring in a distribution that is patchy without filling an entire lobe. Numerous factors, including environmental contaminants and autoimmune diseases, as well as infection, may cause pneumonia. The various infectious agents that cause pneumonia are categorized in many ways for purposes of laboratory testing, epidemiologic study and choice of therapy. Pneumonias occurring in usually healthy persons not confined to an institution are classified as **community-acquired pneumonias**. Infections arise while a patient is hospitalized or living in an institution such as a nursing home are called hospital-acquired or **nosocomial pneumonias**. Etiologic pathogens associated with community-acquired and hospital-acquired pneumonias are somewhat different. However, many organisms can cause both types of infections.

2.3 Pathogenesis and etiology of bacterial pneumonias

Typical pneumonias

Streptococcus pneumoniae is the most common agent of community-acquired acute bacterial pneumonia. More than 80 serotypes, as determined by capsular polysaccharides, are known, but 23 serotypes account for over 90% of all pneumococcal pneumonias in the United States. Pneumonias caused by other streptococci are uncommon. *Streptococcus pyogenes* pneumonia is often associated with a hemorrhagic pneumonitis and empyema. Community-acquired pneumonias caused by *Staphylococcus aureus* are also uncommon and usually occur after influenza or from staphylococcal bacteremia. Infections due to *Haemophilus influenzae* and *Klebsiella pneumoniae* are more common among patients over 50 years old who have chronic obstructive lung disease or alcoholism.

Nosocomial pneumonias

The most common agents of nosocomial pneumonias are aerobic **gram-negative bacilli** that rarely cause pneumonia in healthy individuals. *Pseudomonas aeruginosa*, *Escherichia coli*, *Enterobacter*, *Proteus*, and *Klebsiella* species are often identified.

Tuberculosis

Mycobacterium tuberculosis can cause pneumonia. Although the incidence of tuberculosis is low in industrialized countries, *M tuberculosis* infections still continue to be a significant public health problem in the United States, particularly among immigrants from developing countries, intravenous drug abusers, patients infected with human immunodeficiency virus (HIV), and the institutionalized elderly. Atypical *Mycobacterium* species can cause lung disease indistinguishable from tuberculosis.

Aspiration pneumonias

Aspiration pneumonia from anaerobic organisms usually occurs in patients with periodontal disease or depressed consciousness. The bacteria involved are usually part the oral flora and cultures generally show a mixed bacterial growth. *Actinomyces*, *Bacteroides*, *Peptostreptococcus*, *Veilonella*, *Propionibacterium*, *Eubacterium*, and *Fusobacterium* are often isolated.

Atypical pneumonias

Atypical pneumonias are those that are not typical bacterial lobar pneumonias. *Mycoplasma pneumoniae* produces pneumonia most commonly in young people between 5 and 19 years of age, but also in young adults.

Legionella species, including *L pneumophila*, can cause a wide range of clinical manifestations. The 1976 outbreak in Philadelphia was manifested as a typical serious pneumonia in affected individuals, with a mortality of 17%.

Chlamydia noted to cause pneumonitis are *C. trachomatis*, *C. psittaci* and *C. pneumoniae*. *Chlamydia trachomatis* causes pneumonia in neonates and young infants. *C. psittaci* is a known cause for occupational pneumonitis in bird handlers such as turkey farmers.

Coxiella burnetii is responsible for Q fever, and is acquired by inhalation of aerosols from infected animal placentas and feces. Pneumonitis is one of the major manifestations of this systemic infection.

2.4 Pathogenesis and etiology of viral pneumonias

Viral pneumonias are rare in healthy civilian adults. An exception is the viral pneumonia caused by influenza viruses, which can have a high mortality in the elderly and in patients with underlying disease. A serious complication following influenza virus infection is a secondary bacterial pneumonia, particularly staphylococcal pneumonia. Respiratory syncytial virus can cause serious pneumonia among infants as well as outbreaks among institutionalized adults. Although varicella-zoster virus pneumonitis is rare in children, it is not uncommon in individuals over 19 years old. Morality can be as high as 10% to 30%. Measles pneumonia may occur in adults. **COVID-19 have been the causative of the high mortality due to the pandemic (2020-2022)**.

2.5 Other pneumonias and immunosuppression

Other pathogens, usually associated to pneumonitis (a special inflammation of lung parenchyma), are Cytomegalovirus, Actinomyces, Nocardia, Cryptococcus neoformans and Sporothrix schenckii, Blastomyces dermatitidis, Coccidioides immitis, Histoplasma capsulatum and Paracoccidioides brasiliensis, Aspergillus and Candida.

Pneumocystis jirovecii produces a life-threatening pneumonia among patients immunosuppressed by acquired immune deficiency syndrome (AIDS), hematologic cancers, or medical therapy. It is the most common cause of pneumonia among patients with **AIDS**.

2.6 Pathogenesis and Clinical Manifestations

Infectious agents gain access to the lower respiratory tract by the inhalation of aerosolized material, by aspiration of upper airway flora, or by hematogenous seeding. Pneumonia occurs when lung defense mechanisms are diminished or overwhelmed. The major symptoms or pneumonia are cough, chest pain, fever, shortness of breath and sputum production. Patients are tachycardic. Headache, confusion, abdominal pain, nausea, vomiting and diarrhea may be present, depending on the age of the patient and the organisms involved.

2.7 Microbiologic Diagnosis

Etiologic diagnosis of pneumonia on clinical grounds alone is almost impossible. **Sputum** should be examined for a predominant organism in any patient suspected to have a bacterial pneumonia; blood and pleural fluid (if present) should be cultured. Viral infection may be diagnosed by demonstration of antigen in secretions or cultures or by an antibody response. Serologic studies can be used to identify viruses, M pneumoniae, C. burnetii, Chlamydia species, Legionella, Francisella, and Yersinia.

Rapid diagnostic tests are available to identify respiratory viruses and bacteria (Legionella, S. pneumoniae, etc).

2.8 Prevention and Treatment

Until the organism causing the infection is identified, decisions on therapy are based upon clinical history, including history of exposure, age, underlying disease and previous therapies, past pneumonias, geographic location, severity of illness, clinical symptoms, and sputum examination. Once a diagnosis is made, therapy is directed at the specific organism responsible.

The pneumococcal vaccine should be given to patients at high risk for developing pneumococcal infections, including asplenic patients, the elderly and any patients immunocompromised through disease or medical therapy. Yearly influenza vaccinations should also be provided for these particular groups.