

Study Outline Chapter 24

Introduction (p. 630)

- Infections of the upper respiratory system are the most common type of infection.
- Pathogens that enter the respiratory system can infect other parts of the body.

Structure and Function of the Respiratory System (pp. 630- 632)

- The upper respiratory system consists of the nose, pharynx, and associated structures, such as the middle ear and auditory tubes.
- Coarse hairs in the nose filter large particles from air entering the respiratory tract.
- The ciliated mucous membranes of the nose and throat trap airborne particles and remove them from the body.
- Lymphoid tissue, tonsils, and adenoids provide immunity to certain infections.
- The lower respiratory system consists of the larynx, trachea, bronchial tubes, and alveoli.
- The ciliary escalator of the lower respiratory system helps prevent microorganisms from reaching the lungs.
- Microbes in the lungs can be phagocytized by alveolar macrophages.
- Respiratory mucus contains IgA antibodies.

Normal Microbiota of the Respiratory System (p. 632)

- The normal microbiota of the nasal cavity and throat can include pathogenic microorganisms.
- The lower respiratory system is usually sterile because of the action of the ciliary escalator.

Microbial Diseases of the Upper Respiratory System (pp. 632- 636)

- Specific areas of the upper respiratory system can become infected to produce pharyngitis, laryngitis, tonsillitis, sinusitis, and epiglottitis.
- These infections may be caused by several bacteria and viruses, often in combination.
- Most respiratory tract infections are self-limiting.
- *H. influenzae* type b can cause epiglottitis.

Bacterial Diseases of the Upper Respiratory System (pp. 632- 635)

Streptococcal Pharyngitis (Strep Throat)(pp. 632- 633)

- This infection is caused by group A b-hemolytic streptococci, the group that consists of *Streptococcus pyogenes*.
- Symptoms of this infection are inflammation of the mucous membrane and fever; tonsillitis and otitis media may also occur.
- Preliminary rapid diagnosis is made by indirect agglutination tests. Definitive diagnosis is based on a rise in IgM antibodies.
- Penicillin is used to treat streptococcal pharyngitis.

- Immunity to streptococcal infections is type-specific.
- Strep throat is usually transmitted by droplets but at one time was commonly associated with unpasteurized milk.

Scarlet Fever (p. 633)

- Strep throat, caused by an erythrogenic toxin-producing *S. pyogenes*, results in scarlet fever.
- *S. pyogenes* produces erythrogenic toxin when lysogenized by a phage.
- Symptoms include a red rash, high fever, and a red, enlarged tongue.

Diphtheria (pp. 634- 635)

- Diphtheria is caused by exotoxin-producing *Corynebacterium diphtheriae*.
- Exotoxin is produced when the bacteria are lysogenized by a phage.
- A membrane, containing fibrin and dead human and bacterial cells, forms in the throat and can block the passage of air.
- The exotoxin inhibits protein synthesis, and heart, kidney, or nerve damage may result.
- Laboratory diagnosis is based on isolation of the bacteria and the appearance of growth on differential media.
- Antitoxin must be administered to neutralize the toxin, and antibiotics can stop growth of the bacteria.
- Routine immunization in the U.S. includes diphtheria toxoid in the DTP vaccine.
- Slow-healing skin ulcerations are characteristic of cutaneous diphtheria.
- There is minimal dissemination of the exotoxin in the bloodstream.

Otitis Media (p. 635)

- Earache, or otitis media, can occur as a complication of nose and throat infections.
- Pus accumulation causes pressure on the eardrum.
- Bacterial causes include *Streptococcus pneumoniae*, *nonencapsulated Hemophilus influenzae*, *Moraxella (Branhamella) catarrhalis*, *Streptococcus pyogenes*, and *Staphylococcus aureus*.

Viral Disease of the Upper Respiratory System (pp. 635- 636)

The Common Cold (p. 635- 636)

- Any one of approximately 200 different viruses can cause the common cold; rhinoviruses cause about 50% of all colds.
- Symptoms include sneezing, nasal secretions, and congestion.
- Sinus infections, lower respiratory tract infections, laryngitis, and otitis media can occur as complications of a cold.
- Colds are most often transmitted by indirect contact.
- Rhinoviruses prefer temperatures slightly lower than body temperature.
- The incidence of colds increases during cold weather, possibly because of increased interpersonal indoor contact or physiological changes.
- Antibodies are produced against the specific viruses.

Microbial Diseases of the Lower Respiratory System (pp. 636- 651)

- Many of the same microorganisms that infect the upper respiratory system also

infect the lower respiratory system.

- Diseases of the lower respiratory system include bronchitis and pneumonia.

Bacterial Diseases of the Lower Respiratory System (pp. 636- 645)

Pertussis (Whooping Cough) (pp. 636- 637)

- Pertussis is caused by *Bordetella pertussis*.
- The initial stage of pertussis resembles a cold and is called the catarrhal stage.
- The accumulation of mucus in the trachea and bronchi causes deep coughs characteristic of the paroxysmal (second) stage.
- The convalescence (third) stage can last for months.
- Laboratory diagnosis is based on isolation of the bacteria on enrichment and selective media, followed by serological tests.
- Regular immunization for children has decreased the incidence of pertussis.

Tuberculosis (pp. 637- 641)

- Tuberculosis is caused by *Mycobacterium tuberculosis*.
- Large amounts of lipids in the cell wall account for the bacterium's acid-fast characteristic as well as its resistance to drying and disinfectants.
- *M. tuberculosis* may be ingested by alveolar macrophages; if not killed, the bacteria reproduce in the macrophages.
- Lesions formed by *M. tuberculosis* are called tubercles; dead macrophages and bacteria form the caseous lesion that might calcify and appear in an X ray as a Ghon complex.
- Liquefaction of the caseous lesion results in a tuberculous cavity in which *M. tuberculosis* can grow.
- New foci of infection can develop when a caseous lesion ruptures and releases bacteria into blood or lymph vessels; this is called miliary tuberculosis.
- Miliary tuberculosis is characterized by weight loss, coughing, and loss of vigor.
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- Chemotherapy usually involves two drugs taken for 1- 2 years; multidrug-resistant *M. tuberculosis* is becoming prevalent.
- A positive tuberculin skin test can indicate either an active case of TB, or prior infection, or vaccination and immunity to the disease.
- Laboratory diagnosis is based on the presence of acid-fast bacilli and isolation of the bacteria, which requires incubation of up to 8 weeks. 11. *Mycobacterium bovis* causes bovine tuberculosis and can be transmitted to humans by unpasteurized milk.
- *M. bovis* infections usually affect the bones or lymphatic system.
- BCG vaccine for tuberculosis consists of a live, avirulent culture of *M. bovis*.
- *M. avium-intracellulare* complex infects patients in the late stages of HIV infection.

Bacterial Pneumonias (p. 642)

- Typical pneumonia is caused by *S. pneumoniae*.
- Atypical pneumonias are caused by other microorganisms.

Pneumococcal Pneumonia (p. 642)

- Pneumococcal pneumonia is caused by encapsulated *Streptococcus*

pneumoniae.

- Symptoms are fever, breathing difficulty, chest pain, and rust-colored sputum.
- The bacteria can be identified by the production of α -hemolysins, inhibition by optochin, bile solubility, and through serological tests.
- A vaccine consists of purified capsular material from 23 serotypes of *S. pneumoniae*.

Hemophilus influenzae Pneumonia (pp. 642- 643)

- Alcoholism, poor nutrition, cancer, and diabetes are predisposing factors for *H. influenzae pneumonia*.
- *H. influenzae* is a gram-negative coccobacillus.

Mycoplasmal Pneumonia (p. 643)

- *Mycoplasma pneumoniae* causes mycoplasmal pneumonia; it is an endemic disease.
- *M. pneumoniae* produces small fried-egg colonies after 2 weeks' incubation on enriched media containing horse serum and yeast extract.
- A complement-fixation test, used to diagnose the disease, is based on the rising of antibody titer.

Legionellosis (pp. 643- 644)

- The disease is caused by the aerobic gram-negative rod *Legionella pneumophila*.
- The bacterium can grow in water, such as air-conditioning cooling towers, and then be disseminated in the air.
- This pneumonia does not appear to be transmitted from person to person.
- Bacterial culture, FA tests, and DNA probes are used for laboratory diagnosis.

Psittacosis (Ornithosis) (p. 644)

- *Chlamydia psittaci* is transmitted by contact with contaminated droppings and exudates of fowl.
- Elementary bodies allow the bacteria to survive outside a host.
- Commercial bird handlers are most susceptible to this disease.
- The bacteria are isolated in embryonated eggs, mice, or cell culture; identification is based on FA staining.

Chlamydial Pneumonia (p. 644)

- *Chlamydia pneumoniae* causes pneumonia; it is transmitted from person to person.
- A fluorescent-antibody test is used for diagnosis.

Q Fever (pp. 644- 645)

- Obligately parasitic, intracellular *Coxiella burnetii* causes Q fever.
- The disease is usually transmitted to humans through unpasteurized milk or inhalation of aerosols in dairy barns.
- Laboratory diagnosis is made with the culture of bacteria in embryonated eggs or cell culture.

Other Bacterial Pneumonias (p. 645)

- Gram-positive bacteria that cause pneumonia include *S. aureus* and *S. pyogenes*.

- Gram-negative bacteria that cause pneumonia include *M.(B.) catarrhalis*, *K. pneumoniae*, and *Pseudomonas species*.

Viral Diseases of the Lower Respiratory System (pp. 645- 648)

Viral Pneumonia (p. 645)

- A number of viruses can cause pneumonia as a complication of infections such as influenza.
- The etiologies are not usually identified in a clinical laboratory because of the difficulty in isolating and identifying viruses.

Respiratory Syncytial Virus (RSV) (p. 645)

- RSV is the most common cause of pneumonia in infants.

Influenza (Flu) (pp. 646- 648)

- Influenza is caused by Influenzavirus and is characterized by chills, fever, headache, and general muscular aches.
- Hemagglutinin (H) and neuraminidase (N) spikes project from the outer lipid bilayer of the virus.
- Viral strains are identified by antigenic differences in the H and N spikes; they are also divided by antigenic differences in their protein coats (A, B, and C).
- Viral isolates are identified by hemagglutination-inhibition tests and immunofluorescence testing with monoclonal antibodies.
- Antigenic shifts that alter the antigenic nature of the H and N spikes make natural immunity and vaccination of questionable value. Minor antigenic changes are caused by antigenic drift.
- Deaths during an influenza epidemic are usually from secondary bacterial infections.
- Multivalent vaccines are available for the elderly and other high-risk groups.
- Amantadine and rimantadine are effective prophylactic and curative drugs against A-type *Influenzavirus*.

Fungal Diseases of the Lower Respiratory System (pp. 648- 651)

- Fungal spores are easily inhaled; they may germinate in the lower respiratory tract.
- The incidence of fungal diseases has been increasing in recent years.
- The mycoses below can be treated with amphotericin B.

Histoplasmosis (p. 648)

- *Histoplasma capsulatum* causes a subclinical respiratory infection that only occasionally progresses to a severe, generalized disease.
- The disease is acquired by inhalation of airborne conidia.
- Isolation of the fungus or identification of the fungus in tissue samples is necessary for diagnosis.

Coccidioidomycosis (pp. 648- 649)

- Inhalation of the airborne arthrospores of *Coccidioides immitis* can result in coccidioidomycosis.
- Most cases are subclinical, but when there are predisposing factors such as fatigue and poor nutrition, a progressive disease resembling tuberculosis can

result.

Pneumocystis Pneumonia (pp. 649- 650)

- *Pneumocystis carinii*, currently classified as a fungus, is found in healthy human lungs.
- *Pneumocystis carinii* causes disease in immunosuppressed patients.
- *Pneumocystis pneumonia* is currently being treated with trimethoprim or pentamidine.

Blastomycosis (North American Blastomycosis) (p. 651)

- *Blastomycosis dermatidis* is the causative agent of blastomycosis.
- The infection begins in the lungs and can spread to cause extensive abscesses.

Other Fungi Involved in Respiratory Disease (p. 651)

- Opportunistic fungi can cause respiratory disease in immunosuppressed hosts, especially when large numbers of spores are inhaled.
- Among these fungi are *Aspergillus*, *Rhizopus*, and *Mucor*.