

## Chapter 24 Microbial Diseases of the Respiratory System

### The Upper Respiratory System

- Nose
- Pharynx (throat)
- Middle ear
- Eustachian tubes

### The Lower Respiratory System

- Larynx
- Trachea
- Bronchial tubes
- Alveoli
- Pleura

### Normal Microbiota of Respiratory System

- Suppress pathogens by competitive inhibition in upper respiratory system
- Lower respiratory system is sterile

### Check Understanding

- What is the function of hairs in the nasal passages?  
24-1
- Normally, the lower respiratory tract is nearly sterile. What is the primary mechanism responsible?  
24-2

### Upper Respiratory System Diseases

- Pharyngitis
- Laryngitis
- Tonsillitis
- Sinusitis
- Epiglottitis: *H. influenzae* type b

### Streptococcal Pharyngitis

- Also called strep throat
- *Streptococcus pyogenes*
- Resistant to phagocytosis
- Streptokinases lyse clots
- Streptolysins are cytotoxic
- Diagnosis by enzyme immunoassay (EIA) tests

### Scarlet Fever

- *Streptococcus pyogenes*
- Pharyngitis
- Erythrogenic toxin produced by lysogenized *S. pyogenes*

### Diphtheria

- *Corynebacterium diphtheriae*: Gram-positive rod
- Diphtheria toxin produced by lysogenized *C. diphtheriae*
- Diphtheria membrane: Fibrin, tissue, bacterial cells
- Prevented by DTaP vaccine
  - Diphtheria toxoid
- Cutaneous diphtheria
  - Infected skin wound leads to slow-healing ulcer

### Otitis Media

- *S. pneumoniae* (35%)
- *H. influenzae* (20–30%)
- *M. catarrhalis* (10–15%)
- *S. pyogenes* (8–10%)
- *S. aureus* (1–2%)
- Incidence of *S. pneumoniae* reduced by vaccine

### The Common Cold

- Rhinoviruses (50%)
- Coronaviruses (15–20%)

### Picornaviridae

- Single-stranded RNA, + strand, nonenveloped
- Enterovirus
- Poliovirus and coxsackievirus
- Rhinovirus
- Hepatitis A virus

### Coronaviridae

- Single-stranded RNA, + strand, enveloped
- Upper respiratory infections
- Coronavirus
- SARS

### Check Understanding

- Which one of the following is most likely to be associated with a headache: pharyngitis, laryngitis, sinusitis, or epiglottitis? 24-3
- Among streptococcal pharyngitis, scarlet fever, or diphtheria, which two diseases are usually caused by the same genus of bacteria? 24-4
- Which viruses, rhinoviruses or coronaviruses, cause about half of cases of the common cold? 24-5

### Lower Respiratory System Diseases

- Bacteria, viruses, and fungi cause
- Bronchitis
- Bronchiolitis
- Pneumonia

### Pertussis (Whooping Cough)

- *Bordetella pertussis*
  - Gram-negative coccobacillus
- Capsule
- Tracheal cytotoxin of cell wall damaged ciliated cells
- Pertussis toxin
- Prevented by DTaP vaccine (acellular Pertussis cell fragments)
- Stage 1: Catarrhal stage, like common cold
- Stage 2: Paroxysmal stage—violent coughing sieges
- Stage 3: Convalescence stage

## Chapter 24

### Microbial Diseases of the Respiratory System

#### Tuberculosis

- *Mycobacterium tuberculosis*
  - Acid-fast rod; transmitted from human to human
- *M. bovis*: <1% U.S. cases; not transmitted from human to human
- *M. avium-intracellulare* complex infects people with late-stage HIV infection
- Treatment: Prolonged treatment with multiple antibiotics
- Vaccines: BCG, live, avirulent *M. bovis*; not widely used in United States
- Tuberculin skin test screening
  - Positive reaction means current or previous infection
  - Followed by X-ray or CT exam, acid-fast staining of sputum, culturing of bacteria

#### Pneumococcal Pneumonia

- *Streptococcus pneumoniae*
  - Gram-positive encapsulated diplococci
- Symptoms: Infected alveoli of lung fill with fluids; interferes with oxygen uptake
- Diagnosis: Optochin-inhibition test or bile solubility test; serological typing of bacteria
- Treatment: Penicillin, fluoroquinolones
- Prevention: Pneumococcal vaccine

#### *Haemophilus influenzae* Pneumonia

- Gram-negative coccobacillus
- Predisposing factors: Alcoholism, poor nutrition, cancer, or diabetes
- Symptoms: Resemble those of pneumococcal pneumonia
- Diagnosis: Isolation; special media for nutritional requirements
- Treatment: Cephalosporins

#### Mycoplasma Pneumonia

- Primary atypical pneumonia; walking pneumonia
- *Mycoplasma pneumoniae*
  - Pleomorphic, wall-less bacteria
- Common in children and young adults
- Symptoms: Mild but persistent respiratory symptoms; low fever, cough, headache
- Diagnosis: PCR and serological testing
- Treatment: Tetracyclines

#### Legionellosis

- *Legionella pneumophila*
  - Gram-negative rod
- Found in water
- Transmitted by inhaling aerosols; not transmitted from human to human
- Symptoms: Potentially fatal pneumonia that tends to affect older men who drink or smoke heavily

- Diagnosis: Culture on selective media, DNA probe
- Treatment: Erythromycin

#### Psittacosis (Ornithosis)

- *Chlamydia psittaci*
  - Gram-negative intracellular bacterium
- Transmitted to humans by elementary bodies from bird droppings
- Reorganizes into reticulate body after being phagocytized
- Symptoms: Symptoms, if any, are fever, headache, chills
- Diagnosis: Growth of bacteria in eggs or cell culture
- Treatment: Tetracyclines

#### Chlamydial Pneumonia

- *Chlamydia pneumoniae*
- Transmitted from human to human
- Symptoms: Mild respiratory illness common in young people; resembles mycoplasma pneumoniae
- Diagnosis: Serological tests
- Treatment: Tetracyclines

#### Q Fever

- Causative agent: *Coxiella burnetii*
- Reservoir: Large mammals
- Tick vector
- Can be transmitted via unpasteurized milk
- Symptoms: Mild respiratory disease lasting 1–2 weeks; occasional complications such as endocarditis occur
- Diagnosis: Growth in cell culture
- Treatment: Doxycycline and chloroquine

#### Melioidosis

- Causative agent: by *Burkholderia pseudomallei*
- Reservoir: Soil
- Mainly in southeast Asia and northern Australia
- Symptoms: Pneumonia, or tissue abscesses and severe sepsis
- Diagnosis: Bacterial culture
- Treatment: Ceftazidime

#### Check Understanding

- Another name for pertussis is whooping cough. This symptom is caused by the pathogens' attack on which cells? 24-6
- What group of bacterial pathogens causes what is informally called "walking pneumonia"? 24-7
- The bacterium causing melioidosis in humans also causes a disease of horses known as what? 24-8

## Chapter 24

### Microbial Diseases of the Respiratory System

#### Viral Pneumonia

- Viral pneumonia occurs as a complication of influenza, measles, or chickenpox
- Viral etiology suspected if no other cause is determined

#### Respiratory Syncytial Virus (RSV)

- Common in infants; 4500 deaths annually
- Causes cell fusion (syncytium) in cell culture
- Symptoms: Pneumonia in infants
- Diagnosis: Serological test for viruses and antibodies
- Treatment: Ribavirin, palivizumab

#### Paramyxoviridae

- Single-stranded RNA, – strand, one RNA strand
- Paramyxovirus
- Morbillivirus
- Parainfluenza
- Mumps
- Newcastle disease (chickens)

#### Influenza (Flu)

- Symptoms: Chills, fever, headache, and muscle aches
- No intestinal symptoms
- 1% mortality, very young and very old
- Treatment: Zanamivir and oseltamivir inhibit neuraminidase
- Prophylaxis: Multivalent vaccine
- Hemagglutinin (HA) spikes used for attachment to host cells
- Neuraminidase (NA) spikes used to release virus from cell

#### Orthomyxoviridae

- Single-stranded RNA, – strand, multiple RNA strands
- Envelope spikes can agglutinate RBCs
- Influenzavirus (influenza viruses A and B)
- Influenza C virus

#### The Influenza Virus

- Antigenic shift
- Changes in HA and NA spikes
- Probably due to genetic recombination between different strains infecting the same cell
- Antigenic drift
- Point mutations in genes encoding HA or NA spikes
- May involve only 1 amino acid
- Allows virus to avoid mucosal IgA antibodies

#### Check Understanding

- Is reassortment of the RNA segments of the influenza virus the cause of antigenic shift or antigenic drift? 24-9

#### Histoplasmosis

- *Histoplasma capsulatum*, dimorphic fungus

#### Coccidioidomycosis

- Causative agent: *Coccidioides immitis*
- Reservoir: Desert soils of Southwest U.S.
- Symptoms: Fever, coughing, weight loss
- Diagnosis: Serological tests
- Treatment: Amphotericin B

#### Pneumocystis Pneumonia

- Causative agent: *Pneumocystis jirovecii*
- Reservoir: Unknown; possibly humans or soil
- Symptoms: Pneumonia
- Diagnosis: Microscopy
- Treatment: Trimethoprim

#### Blastomycosis

- Causative agent: *Blastomyces dermatitidis*
- Reservoir: Soil in Mississippi valley area
- Symptoms: Abscesses; extensive tissue damage
- Diagnosis: Isolation of pathogen
- Treatment: Amphotericin B

#### Other Fungi Involved in Respiratory Disease

- Systemic
- Predisposing factors:
  - Immunocompromised state
  - Cancer
  - Diabetes
- *Aspergillus fumigatus*
- *Mucor*
- *Rhizopus*

#### Check Understanding

- The droppings of both blackbirds and bats support the growth of *Histoplasma capsulatum*; which of these two animal reservoirs is normally actually infected by the fungus? 24-10