

Respiratory System Infections

Lecture 18 – Dr. Gary Mumaugh

Antibacterial, Antiviral & Antifungal Therapy

Principles of Antibiotic Treatment

- In western care, the goal is to start first with broad-spectrum antibiotics, then switch to narrower within three days when C & S (cultures and sensitivities) have been identified
- “Scattergun approach” is common in medical practice
 - The hope that the antibiotic prescribed may be able to cure the infections without any lab data to support it
 - This approach is largely due to the fact that the patient expects an RX at every visit
 - Great numbers of patients are given antibiotics that may not have been necessary or appropriate
 - One or two antibiotics cannot fulfill all the treatment goal
 - Many providers tend to have a small number of “favorite” antibiotics that they will prescribe for most infections, often without checking C & S to determine if treatment is appropriate
 - Increased numbers of resistant strains are being discovered daily

Narrow spectrum to broad spectrum

- Narrow-spectrum
 - Penicillin, Oxacillin, Keflin, Keflex, Gentamycin, Vanomycin, flagyl
- Moderately broad-based spectrum
 - Ampicillin, Ticarcillin, Piperacillin, Kefzol, Cipro, Bactrim, Spectrum
- Broad-spectrum
 - Ampicillin-sulbactam, Amoxicillin, Ceftriaxone, Tetracycline, Doxycycline, Levofloxin
- Very broad-spectrum
 - Ticarcillin, Imipenim, Moxifloxacin

The cost of antibiotics

- Orals can cost as little as \$5-\$40 for 10 days
 - Tetracycline, Erythromycin, Keflex
- High end cost of \$160-#200 for 10 days
 - Azithromycin, Clarithromycin, Moxafloxin
- IV antibiotics
 - From \$20-\$60 per day on low end
 - To up to \$200 per day on the high end

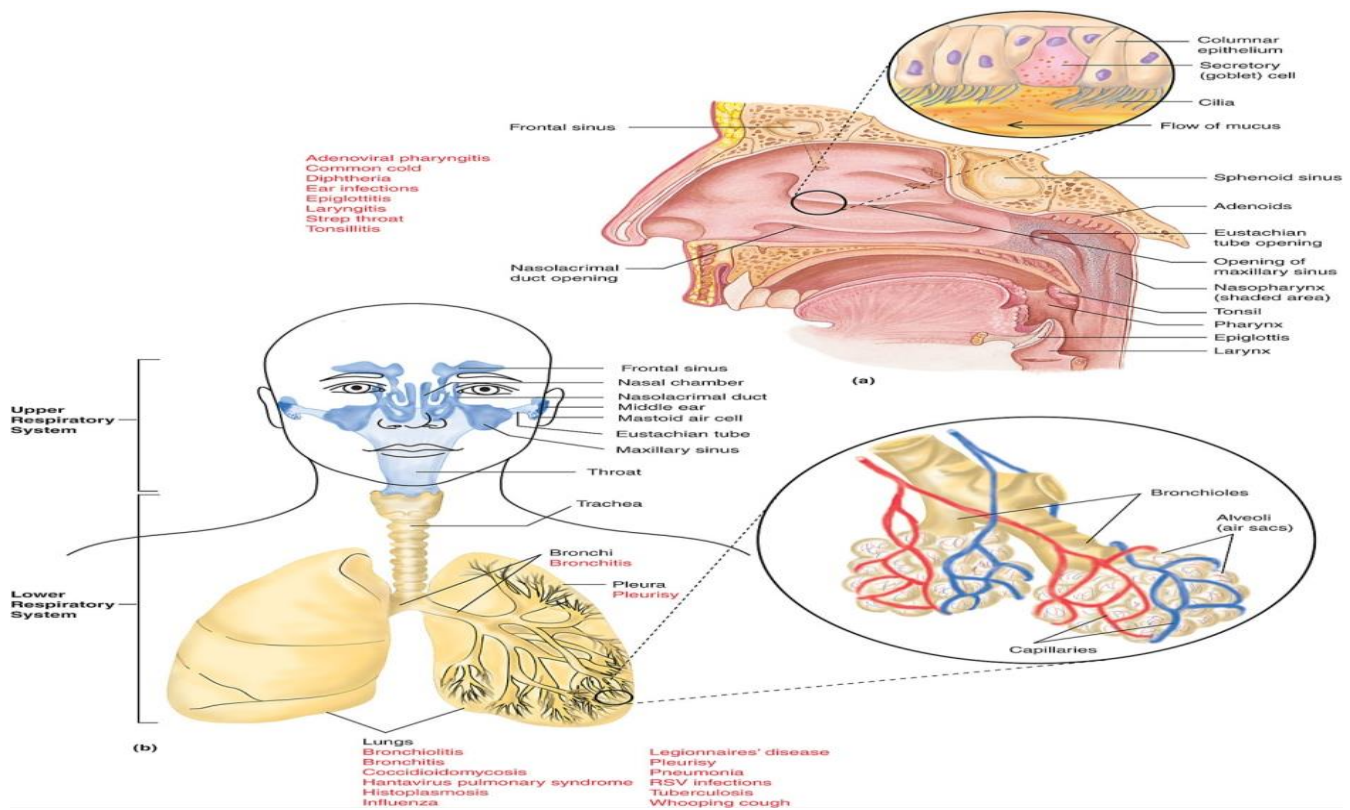
Respiratory and EENT Infections

Respiratory System Infections

- Encompass enormous variety of illnesses
 - Trivial to fatal
- Divided into infections of
- Upper respiratory
 - Head and neck
 - Uncomfortable but generally not life threatening
- Lower respiratory
 - Chest
 - More serious
 - Can be life threatening
 - Particularly in the immunocompromised

Normal Microbiota

- Nasal cavity, nasopharynx and pharynx colonized by numerous bacteria
 - Other sites are sterile
 - Numerous classes of organisms are present from aerobes to anaerobes
- Conjunctiva commonly have no bacteria
 - Organisms that do invade are swept into the nasolacrimal duct (tear duct) and nasopharynx



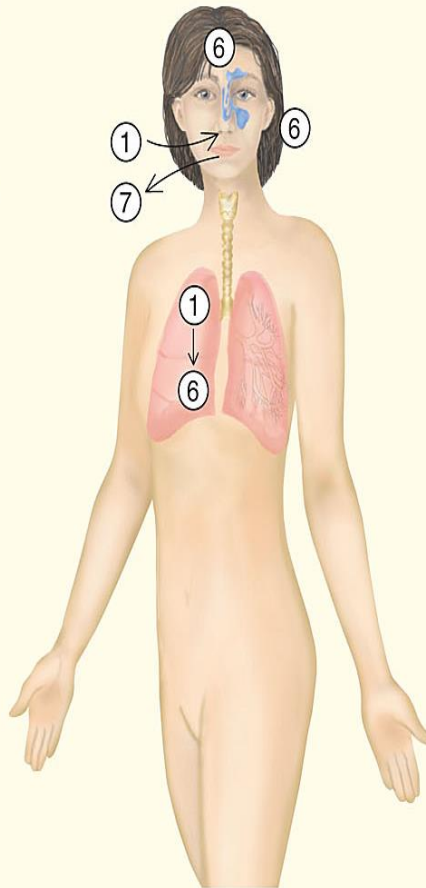
Genus	Characteristics	Comments
<i>Staphylococcus</i>	Gram-positive cocci in clusters	Commonly includes the potential pathogen <i>Staphylococcus aureus</i> , inhabiting the nostrils. Facultative anaerobes.
<i>Corynebacterium</i>	Pleomorphic, Gram-positive rods; non-motile; non-spore-forming	Aerobic or facultatively anaerobic. Diphtheroids include anaerobic and aerotolerant organisms.
<i>Moraxella</i>	Gram-negative diplococci and diplobacilli	Aerobic. Some microscopically resemble pathogenic <i>Neisseria</i> species such as <i>N. meningitidis</i> .
<i>Haemophilus</i>	Small, Gram-negative rods	Facultative anaerobes. Commonly include the potential pathogen <i>H. influenzae</i> .
<i>Bacteroides</i>	Small, pleomorphic, Gram-negative rods	Obligate anaerobes.
<i>Streptococcus</i>	Gram-positive cocci in chains	α (especially viridans, meaning green hemolysis), β (clear hemolysis), and γ (non-hemolytic) types; the potential pathogen, <i>S. pneumoniae</i> is often present. Aerotolerant (obligate fermenters).

Influenza

- A major cause of death worldwide
 - Bird flu pandemic at the end of WWI caused 50 million worldwide deaths
 - Current bird flu beginning to see a resurgence
 - Resultant new strains are what causes pandemics
- S & S
 - Dramatic and abrupt with malaise, chills, cough, fever (3 days), rhinorrhea, cervical adenopathy
 - Virus kills the respiratory epithelium causing pulmonary function decline
 - Major complication is viral pneumonia
- Mortality is high and has not been reduced for decades
- Diagnosis
 - Diagnosis is usually confirmed by isolation via blood work
 - Difficult to distinguish from other respiratory diseases
- Treatment
 - Never use ASA with flu which can cause Reye's syndrome (fatty liver infiltration, mental changes, lethargy, delirium, coma)
 - Prevention has been shown to be the best defense
 - Amantidine and Zanamavir (nasal inhalers) are sometimes given early with mixed results

Influenza

- ① Influenza virus is inhaled and carried to the lungs.
- ② Viral hemagglutinin attaches to specific receptors on ciliated epithelial cells, the viral envelope fuses with the epithelial cell, and the virus enters the cell by endocytosis.
- ③ Host cell synthesis is diverted to synthesizing new virus.
- ④ Newly formed virions bud from infected cells, they are released by viral neuraminidase and infect ciliated epithelium, mucus-secreting, and alveolar cells.
- ⑤ Infected cells ultimately die and slough off; recovery of the mucociliary escalator may take weeks.
- ⑥ Secondary bacterial infection of the lungs, ears, and sinuses is common.
- ⑦ The virus exits with coughing.



Symptoms	Fever, muscle aches, lack of energy, headache, sore throat, nasal congestion, cough
Incubation period	1 to 2 days
Causative agent	Influenza virus, an orthomyxovirus
Pathogenesis	Infection of respiratory epithelium; cells destroyed and virus released to infect other cells. Secondary bacterial infection results from damaged mucociliary escalator.
Epidemiology	Antigenic drift and antigenic shift thwart immunity.
Prevention and treatment	Vaccines usually 80% to 90% effective. Amantadine and rimantadine are sometimes effective for preventing type A but not type B virus disease; neuraminidase inhibitors effective against both A and B viruses. These medications somewhat effective for treatment when given early in the disease.

Swine Flu (H1N1) Virus

- Is a subtype of influenza A virus and the most common cause of influenza (flu) in humans.
- Some strains of H1N1 are endemic in humans and cause a small fraction of all influenza-like illness and a small fraction of all seasonal influenza.
- Swine flu (swine influenza) is a respiratory disease caused by viruses that infect the respiratory tract of pigs and result in nasal secretions, a barking-like cough, decreased appetite, and listless behavior
- H1N1 flu is contagious
- H1N1 flu is NOT caused by eating pork or pork products
- Illness with the new H1N1 flu virus has ranged from mild to severe
- About 70 percent of people who have been hospitalized with H1N1 flu have had one or more medical conditions that placed them in the “high risk” category
 - These include pregnancy, diabetes, heart disease, asthma and kidney disease.
- Seniors (adults 65 years and older) are prioritized for antiviral treatment to limit risk of complication if they get flu

Seasonal Flu vs. H1N1 Flu Symptoms

- Seasonal flu
 - Fever
 - Coughing and/or sore throat
 - Runny or stuffy nose
 - Headaches and/or body aches
 - Chills
 - Fatigue
- H1N1 Flu
 - Similar to seasonal flu, but symptoms may be more severe.
 - There may be additional symptoms. A significant number of H1N1 flu cases:
 - Vomiting
 - Diarrhea

Emergency Warning Signs of Children vs. Adults

- In Children
 - Fast breathing or trouble breathing
 - Bluish or gray skin color
 - Not drinking enough fluids
 - Severe or persistent vomiting
 - Not waking up or not interacting
 - Being so irritable that the child does not want to be held
 - Flu-like symptoms improve but then return with fever and worse cough
- In Adults
 - Difficulty breathing or shortness of breath
 - Pain or pressure in the chest or abdomen
 - Sudden dizziness
 - Confusion
 - Severe or persistent vomiting
 - Flu-like symptoms improve but then return with fever and worse cough

Diagnosis of H1N1

- If the symptoms indicate the presence of the H1N1 flu, the physician usually performs a nasopharyngeal swab test to determine if the H1N1 virus is present. If it is present, the flu is diagnosed
- The test is performed by inserting a thin cotton swab two inches into the nostril, aimed towards the throat.

Treatment of H1N1

- Antiviral Therapy
 - Efficacy — Therapy should be started as soon as possible, since evidence of benefit is strongest for seasonal influenza when treatment is started within 48 hours of illness onset
 - At this time, treatment with Tamiflu® or Relenza® is recommended for all people with suspected or confirmed influenza who require hospitalization
 - The recommended duration of treatment is five days

Conjunctivitis – “Pink Eye”

- Rubbing causes transfer to other eyes
- Tears contain antibacterial agents
- Viral conjunctivitis
 - The most common and most contagious
- Bacterial conjunctivitis
 - Is common in developing countries with copious amounts of pus
- Allergic conjunctivitis
 - From sensitivity to environmental antigens
- Symptoms - Pinkeye
 - Increased tears and redness
 - Swelling eyelids
 - Sensitivity to bright light
 - Large amounts of pus
- Pathogenesis
 - Few details known about pathogenesis of bacterial conjunctivitis
 - Most likely from airborne respiratory droplets
 - Resist destruction by lysozyme
- Prevention
 - Prevention is directed towards
 - Removal of infected individuals from school or day care
 - Hand washing
 - Avoid rubbing or touching eyes
 - Avoid sharing towels
 - Treatment is achieved through eye drops or ointments containing antibacterial medications



Keratitis – corneal infection

- The most common form from *Staphylococci*
- Viral keratitis
 - Caused by herpes simplex resulting in corneal ulcer
 - Giving cortisone or eye drops with cortisone can worsen the condition to blindness
- Parasitic keratitis
 - Commonly seen in contact lens wearers who wash their lens with tap water
- Reactive keratitis
 - Not caused by an infection
 - Thought to be an autoimmune reaction and resolves in 2-3 years with considerable problems
 - Also caused by towel slapping in locker rooms

Otitis externa – “swimmers ear”

- Is usually a mild annoyance
- Can be more severe in swimmers who swim daily
- Water trapped in the ear causes irritation, low grade infection and itching
- S & S
 - Otolgia and otorrhea with pruritis to severe pain, swelling can occlude canal with hearing loss
- DX
 - Elevated ESR, bone scan & CT scan to diagnose osteomyelitis
- TX
 - Mild cases – polymycin and cortisone drops
 - Severe cases – IV antibiotics and debridement

Otitis externa – “swimmers ear”



Otitis media – middle ear infection

- Common in preschool and school age children
- Eustachian tube development
- Bacteria from mouth and pharynx travel up the tube to the middle ear
- S & S
 - Fever, vertigo, tinnitus and pain, nystagmus
- DX
 - Requires the presence of fluid & redness or inflammation
- TX
 - Amoxicillin 10 days, Augmentin in severe cases

Two Types of Otitis Media

- Acute Otitis Media
 - Inflammatory symptoms of pain, fever, malaise
 - 80% of cases resolve in 24 hours

Otitis media - continued

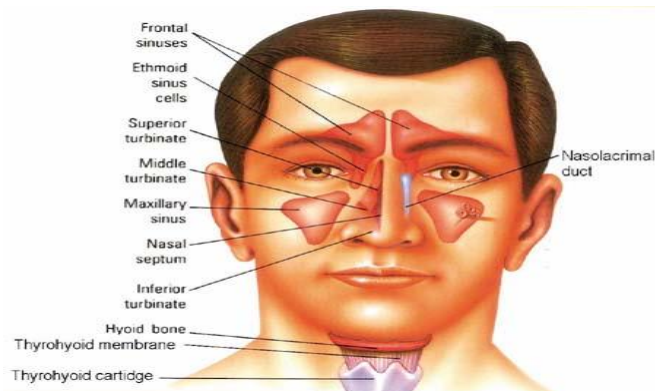
- Serous Otitis Media
 - Presents with effusion of fluid in the middle ear
 - Most frequent diagnosis in children under 15
 - Studies have shown no bacterial pathogen 65% of the time
 - Serous fluid may remain for up to 12 weeks after an acute episode
- Otitis Media history
 - History begins with resolution of signs and symptoms including effusion
- Clinical Manifestations
 - Uncomplicated Otitis Media
 - Unilateral
 - Mild fever or no fever
 - No perforation of eardrum, little or no membrane bulging
 - Well appearance
 - Mild pain
- Clinical Manifestations
 - Complicated Otitis Media
 - Perforation of tympanic membrane
 - Suppuration
 - Mastoiditis
 - High Fever
 - Sick appearance
 - Severe pain
- Anatomic Considerations
 - Eustachian tube in infants and small children is very small and narrow. It connects the inner ear to back of nose
 - In infants, the tube is horizontal and does not drain well
 - As they grow, so grows the tube, allowing for better drainage
 - With less retained fluid, pathogens have less opportunity to cause infection

Sinusitis

- An infection in one or more oral-nasal sinuses
- Symptoms - Sinusitis
 - Pain and pressure
 - Generally localized to involved sinus
 - Tenderness over sinus
 - Headache
 - Severe malaise
- Pathogenesis
 - Begins with infection of nasopharynx
 - Spreads upwards to sinuses
 - Pathogenesis mechanism much like that of otitis media
- Prevention
 - There are no proven preventative measures for sinusitis

Sinusitis - continued

- Treatment is directed at support care
 - Nasal decongestants, Augmentin
 - Decongestants and antihistamines are generally discouraged
 - Ineffective and can be harmful



Mastoiditis

- Infection of the air cells of the mastoid process
- Severe cases can lead to brain abscess
- S & S
 - Severe pain most noticeable with otorrhea
 - Mimics severe suppurative otitis media
- DX
 - Dx by x-rays
 - DD from otitis media by duration and intensity
- TX
 - Augmentin and possible admission with IV



Pharyngitis – common sore throat

- S & S
 - Sore throat, discharge, dry cough, malaise, low grade fever, can have a fulminating infection
- Viral pharyngitis
 - 85% of time in adults
 - Children – 50% viral and 50% bacterial
 - Common causes – rhinovirus, coronavirus, adenovirus, herpes, Epstein-Barr
- Bacterial pharyngitis
 - DD with purulent exudates and tender adenopathy, headache and fever common
 - Usually caused by streptococcus – Dx with throat culture
 - Penicillin in tx for bacterial, but not for viral

Adenoviral Pharyngitis

- Symptoms
 - Runny nose
 - Fever
 - Sore throat
 - Often accompanied with pus on the pharynx and tonsils
 - Lymph nodes in neck enlarged and tender
 - Certain strains of virus cause hemorrhagic conjunctivitis
 - Mild cough is common with infection
 - Cough may worsen; indication of complicating disease
 - Infection usually resolves in 1 to 3 weeks
 - With or without treatment
- Causative Agent - Adenovirus
 - 45 types infect humans
 - Non-enveloped
 - Double-stranded DNA genome
 - Remains infectious in environment for extended periods
 - Transmitted easily on medical instruments
 - Inactivated easily with heat and various disinfectants
- Pathogenesis
 - Virus infects epithelial cells
 - Attaches to specific surface receptors
 - Multiplies in cell nucleus
 - Cells escape to epithelial surface
 - Cell destruction initiates inflammation
 - Different viruses affect different tissues
 - Adenovirus type 4 causes sore throat and lymph node enlargement
 - Adenovirus type 8 causes extensive eye infection

Adenoviral Pharyngitis - continued

- Epidemiology
 - Human is only source of infection
 - Common among school children
 - Usually sporadic; however, outbreaks do occur
 - Most common in winter and spring
 - Summer outbreaks linked to inadequately chlorinated swimming pools
 - Virus spread by respiratory droplets
 - Epidemic spread promoted by high number of asymptomatic carriers
- Prevention and Treatment
 - Prevention is the same as the common cold
 - There is no treatment
 - Patients usually recover uneventfully
 - Bacterial secondary infections may occur requiring antibiotics for treatment
- Antibiotic Dosage for Recurrent Pharyngitis

Drug	Adult Dosage	Pediatric Dosage	Duration
Clindamycin	600 mg orally divided in 2-4 divided doses	20-30 mg/kg/day in 3 divided doses (max:1.8 g/day)	10 days
Amoxicillin-clavulanate	500 mg twice daily	40 mg/kg/day in 3 divided doses	10 days
Penicillin benzathine	1.2 million units intramuscularly for 1 dose	0.6 million units for under 27 kg (50,000 units/kg)	1 dose
Penicillin VK with rifampin	Rifampin: 300 mg PO BID	20 mg/kg/d divided in two equal doses	Last 4 days of treatment with 10 day therapy of penicillin VK

Strep Throat (Streptococcal Pharyngitis)

① *Streptococcus pyogenes* enters by inhalation (nose), or by ingestion (mouth).

② Pharyngitis, fever, enlarged lymph nodes; sometimes tonsillitis, abscess; scarlet fever with strains that produce erythrogenic toxin.

Symptoms go away.

③ *S. pyogenes* exits by nose and mouth.

Late complications appear:

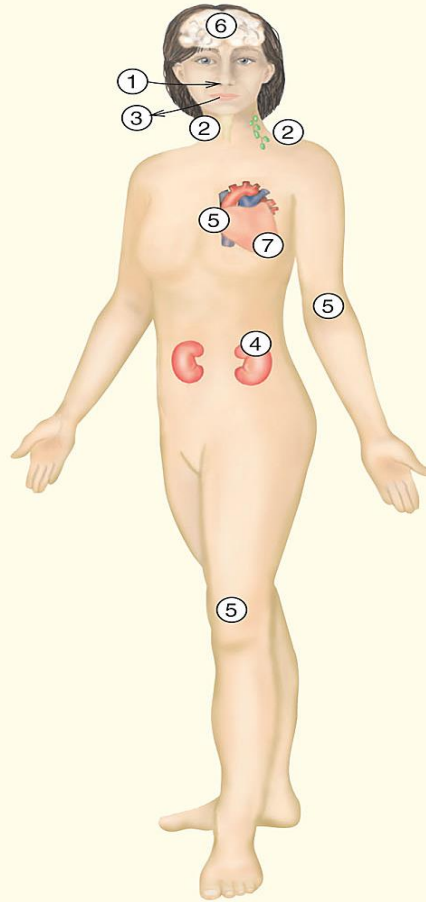
④ glomerulonephritis

⑤ rheumatic fever

⑥ neurological abnormalities

Complications subside.

⑦ Damaged heart valves leak, heart failure develops.



Symptoms

Sore, red throat, with pus and tiny hemorrhages, enlargement and tenderness of lymph nodes in the neck; less frequently, abscess formation involving tonsils; occasionally, rheumatic fever and glomerulonephritis as sequels

Incubation period

2 to 5 days

Causative agent

Streptococcus pyogenes, Lancefield group A β -hemolytic streptococci

Pathogenesis

Virulence associated with hyaluronic acid capsule and M protein, both of which inhibit phagocytosis; protein G binds Fc segment of IgG; protein F for mucosal attachment; multiple enzymes.

Epidemiology

Direct contact and droplet infection; ingestion of contaminated food.

Prevention and treatment

Avoidance of crowding; adequate ventilation; daily penicillin to prevent recurrent infection in those with a history of rheumatic heart disease. Treatment: 10 days of penicillin or erythromycin.

Streptococcal Pharyngitis

- Symptoms - Characterized by
 - Difficulty swallowing
 - Fever
 - Red throat with pus patches
 - Enlarged tender lymph nodes
 - Localized to neck
 - Most patients recover uneventfully in approximately a week
- Pathogenesis
 - Causes a wide variety of illnesses
 - Due to bacteria-producing enzymes and toxin that destroy cells
- Complications of infection can occur during acute illness
- Examples include scarlet fever and quinsy
- Certain complications can develop late
 - Acute glomerulonephritis
 - Acute rheumatic fever

Streptococcal Pharyngitis - continued

- Epidemiology
 - Spread readily by respiratory droplets
 - Especially in range of 2 to 5 feet
 - Infect only humans under natural conditions
 - Nasal organism spreads more effectively than pharyngeal carriers
 - Peak incidence occurs in winter or spring
 - Highest in grade school children
- Prevention
 - No vaccine available
 - Adequate ventilation
 - Avoid crowds
 - Sore throats in presence of fever should be cultured for prompt treatment
 - Prompt treatment is essential to prevent complications
- Treatment
 - Confirmed strep throat treated with 10 days of antibiotics
 - Penicillin or erythromycin are drugs of choice
 - Eliminates organisms in 90% of cases

Peri-tonsillar abscess

- Were very common before antibiotic tx
- S & S
 - Dramatic throat pain on the abscess side with high fever, prostration and dyspnea
- DX
 - Pharyngoscopic examination
- TX
 - Surgical drainage of abscess
 - T & A if >3 episodes of tonsillitis in 1 year
 - Very common from 1940 to 1970

Common Cold

- Symptoms
- Malaise
- Scratchy mild sore throat
- Runny nose
- Cough and hoarseness
- Nasal secretion
 - Initially profuse and watery
 - Later, thick and purulent
 - No fever
 - Unless complicated with secondary infection
- Symptoms disappear in about a week

Common Cold - continued

- Pathogenesis
 - Virus attaches to specific receptors on respiratory epithelial cells and multiplies in cells
 - Large number of viruses released from infected cells
 - Injured cells cause inflammation which stimulates profuse nasal secretion, sneezing and tissue swelling
 - Infection is halted by inflammatory response, interferon release and immune response
 - Infection can extend to ears, sinuses and lower respiratory tract before stopping
- Epidemiology
 - Humans are only source for cold virus
 - Close contact with infected person or secretions usually necessary for transmission
 - High concentrations are found in nasal secretions during first 2 or 3 days of a cold
 - Young children transmit cold virus easily
 - Due to lack of good hygiene
 - No reliable relationship between exposure to cold temperature and development of a cold
- Prevention
 - No vaccine
 - Too many different types of rhinovirus
 - Makes vaccination impractical
 - Prevention directed at
 - Hand washing
 - Keeping hands away from face
 - Avoiding crowds during times when colds are prevalent
- Treatment
 - Antibiotic therapy is ineffectual
 - Certain antiviral medications show promise
 - Must be taken at first onset of symptoms
 - Treatment with over-the-counter medications may prolong duration due to inhibition of inflammation



TABLE 22.5 The Common Cold	
Symptoms	Scratchy throat, nasal discharge, malaise, headache, cough
Incubation period	1 to 2 days
Causative agent	Mainly rhinoviruses—more than 100 types; many other viruses, some bacteria
Pathogenesis	Viruses attach to respiratory epithelium, starting infection that spreads to adjacent cells; ciliary action ceases and cells slough; mucus secretion increases, and inflammatory reaction occurs; infection stopped by interferon release, cellular and humoral immunity.
Epidemiology	Inhalation of infected droplets; transfer of infectious mucus to nose or eye by contaminated fingers; children initiate many outbreaks in families because of lack of care with nasal secretions.
Prevention and treatment	Handwashing; avoiding people with colds and touching face. No generally accepted treatment except for control of symptoms.

Diphtheria

- Symptoms
 - Usually begins with mild sore throat and slight fever, fatigue and malaise and dramatic neck swelling
 - Whitish membrane forms on tonsils, or in nasal cavity
 - Most strains release diphtheria toxin
- Causative Agent
 - *Corynebacterium diphtheria*
 - Variably shaped
 - Gram-positive
 - Non-spore forming
 - Certain strains produce diphtheria toxin
- Pathogenesis
 - Exotoxin released into bloodstream
 - Results in damage to heart, nerves and kidneys
- Epidemiology
 - Humans are primary reservoir
 - Spread by air
 - Acquired through inhalation
 - Sources of infection include
 - Carriers who recovered from infection
 - Asymptomatic cases
 - People with active disease
 - Contaminated objects
 - Bacterium can be carried in chronic skin ulcer - Cutaneous diphtheria

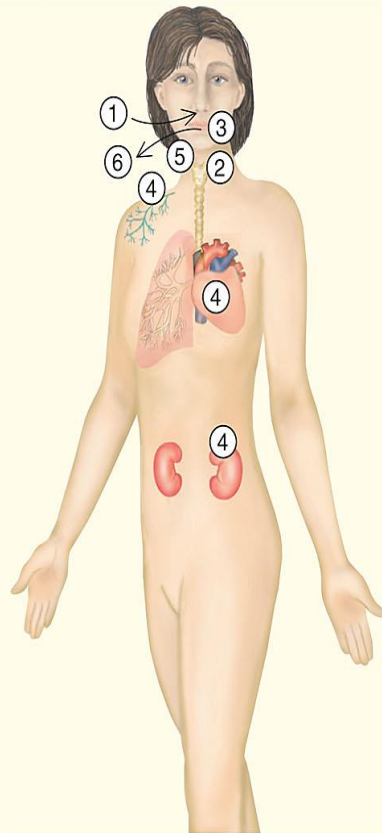


Diphtheria - continued

- Prevention
 - Disease results primarily from toxin absorption
 - Not microbial invasion
 - Prevention directed at immunization
 - DPT - Neutralize toxin
 - Immunity wanes after childhood
 - Booster immunization should be given every 10 years
- Treatment
 - Effectiveness depends on early antiserum treatment
 - Delay in treatment may be fatal
 - Antibiotics are given to eliminate bacteria
 - Penicillin and erythromycin
 - Stops transmission of disease
 - Even in presence of treatment 1 in 10 patients die

TABLE 22.4 Diphtheria

- ① *Corynebacterium diphtheriae* enters by inhalation.
- ② Infection established in nasal cavity and/or throat.
- ③ Toxin released, pseudomembrane forms.
- ④ Toxin causes paralysis, damages heart muscle, kidneys, nerves.
- ⑤ Membrane may come loose and obstruct breathing.
- ⑥ Exit from body by respiratory secretions.



Symptoms	Sore throat, fever, fatigue, and malaise; membrane forms on tonsils and throat or in nose; paralysis, heart and kidney failure
Incubation period	2 to 6 days
Causative agent	<i>Corynebacterium diphtheriae</i> , a toxin-producing, non-spore-forming Gram-positive rod
Pathogenesis	Infection in upper respiratory tract; exotoxin released and absorbed by bloodstream; toxin kills cells by interfering with protein synthesis; effect is on cells that have receptors for the toxin—mainly heart, kidney, and nerve tissue.
Epidemiology	Inhalation of infectious droplets; direct contact with patient or carrier; indirect contact with contaminated articles.
Prevention and treatment	Immunization with diphtheria toxoid; given to children at 6 weeks, 4 months, 6 months, 18 months, and 4 to 6 years; boosters every 10 years. Treatment: antitoxin; erythromycin to prevent transmission.

Whooping Cough

- Symptoms
 - Runny nose followed by bouts of uncontrollable coughing
 - Termed paroxymal coughing
 - Severe cough can cause rupture of small blood vessels in the eyes
 - Coughing spasm followed by characteristic “whoop”
 - Sound made by the forceful inspiration of air
 - Vomiting and seizure may occur
- Causative Agent
 - *Bordetella pertussis*
 - Small
 - Encapsulated
 - Strictly aerobic
 - Gram-negative
 - Bacillus
 - Does not survive long periods outside the host
- Pathogenesis
 - Enters respiratory tract with inspired air and attaches to ciliated cells
 - Organism colonizes structures of the upper and lower respiratory tract
 - Mucous secretion increases which causes ciliary action to decrease
 - Cough reflex is only mechanism for clearing secretions
- Epidemiology
 - Spreads via infected respiratory droplets
 - Most infectious during runny nose period
 - Number of organisms decrease with onset of cough
 - Classically disease of infants
 - Milder forms are seen in older children and adults
 - Often overlooked as a persistent cold
 - Fosters transmission
- Prevention
 - Directed at vaccination of infants
 - Prevents disease in 70% of individuals
 - Pertussis vaccine combined with diphtheria and tetanus toxoids (DPT)
 - Injections given at 6 weeks, 4, 6 and 18 months
- Treatment
 - Erythromycin is effective at reducing symptoms if given early
 - Antibiotic usually eliminates bacteria from respiratory secretions



TABLE 22.8 Pertussis

Symptoms	Runny nose followed after a number of days by spasms of violent coughing; vomiting and possible convulsions
Incubation period	7 to 21 days
Causative agent	<i>Bordetella pertussis</i> , a tiny Gram-negative rod
Pathogenesis	Colonization of the surfaces of the upper respiratory tract and tracheobronchial system; ciliary action slowed; toxins released by <i>B. pertussis</i> cause death of epithelial cells and increased cAMP; fever, excessive mucus output, and a rise in the number of lymphocytes in the bloodstream result.
Epidemiology	Inhalation of infected droplets; older children and adults have mild symptoms.
Prevention and treatment	Acellular vaccines, for immunization of infants and children; erythromycin, somewhat effective if given before coughing spasms start, eliminates <i>B. pertussis</i> .

Pulmonary Infections

Pneumonia

- 2-3 million cases in USA yearly causing 45,000 deaths
 - Mortality is 4 times higher over 65
- Predisposing factors
 - Preceded by viral URI causing cilia damage and the production of serous exudates
 - Smoking impairs mucociliary escalation
 - Elderly and compromised immune systems
 - HIV, AIDS, sickle cell disease, diabetes
 - Organ transplant patients
 - Close indoor quarters in the winter
 - Hypostatic pneumonia can occur from constant laying down

Acute vs. Chronic Pneumonia

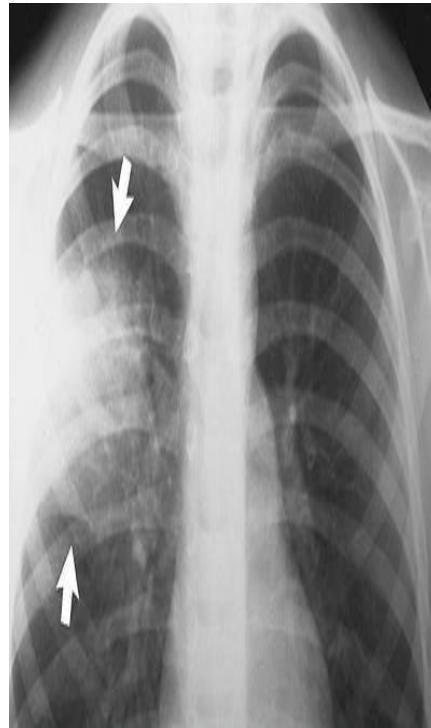
- Acute
 - Symptoms within 1-2 days after exposure
 - Shaking, fever, chills, prostration, dyspnea
 - Common cause of death before antibiotics
- Chronic
 - More slow progressive form
 - Are most viral and fungal pneumonias
 - May last several weeks to months
- Dx based on symptoms
 - Typical pneumonia
 - Rapid onset, productive cough, fever
 - X-ray changes

Pneumonia – continued

- Atypical pneumonia
 - Common with most viral pneumonias
- Dx based on part of the lungs affected
 - Lobar pneumonia
 - “Classic” pneumonia in which all the alveoli sacs in the lobe are pus filled or fluid filled
 - Bronchopneumonia
 - Patchy infiltration throughout the bronchi and bronchioles
 - Interstitial pneumonia
 - In the connective tissue between the alveoli with granular infiltration
 - Lung abscess
 - Organisms destroy tissue and form pus abscess
 - Empyema
 - Purulent infection in the pleural space
 - Nodular lung infections
 - TB, coccidiomycosis and histoplasmosis cause nodular infiltrations
- Dx according to where the pneumonia was acquired
 - Community acquired
 - Acquired anywhere in the community, but not in a hospital
 - Nosocomial
 - Acquired in a hospitalized setting
- Dx according to etiologic agent
 - Pneumococcal pneumonia
 - Classic bacterial pneumonia
 - AKA streptococcal pneumonia
 - Aspiration pneumonia
 - Common in elderly from swallowing gastric or food contents in the trachea
 - Often vomiting with loss on consciousness
 - Hemophilus pneumonia
 - Common on smokers with COPD
 - Staphylococci pneumonia
 - Virulent infection often after influenza
- Dx according to etiologic agent - continued
 - Viral pneumonia
 - Most common form
- S & S of pneumonia
 - Cough, sore throat, fever, chills, rapid breathing, wheezing, dyspnea, chest or abdominal pain, exhaustion, vomiting
- DX of pneumonia
 - Medical history, physical examination, x-ray
- TX of pneumonia
 - Antibiotics, respiratory therapy with oxygen
 - Amoxicillin is first-line therapy
 - Steroids for wheezing

Pneumonia – continued

- Expectorates and lots of fluids
- Codeine for severe pain



Tuberculosis - TB

- One third of world population have active or latent infection resulting in 3 million deaths per year
- Pathology and course of TB
 - A chronic destruction of the lung with scarring
 - Slow progressive lung damage and possible death
 - Systemic symptoms of wasting, fatigue, night sweats, appetite loss – used to be called consumption
- S & S
 - Cough, sputum, hemoptysis, TB spread to organs leads to destruction of organs and organ systems
- DX of classic triad
 - Lung infiltrate, calcified node enlargement, pleural effusion
- TX of TB
 - When it comes to treatment of TB, think slow
 - Slow growth of organisms, slow destruction of lung tissue, prolonged treatment and slow recovery
 - Lasts at least year and is treated with extensive drug therapy with isoniazid and rifampin

Tuberculosis – TB - continued

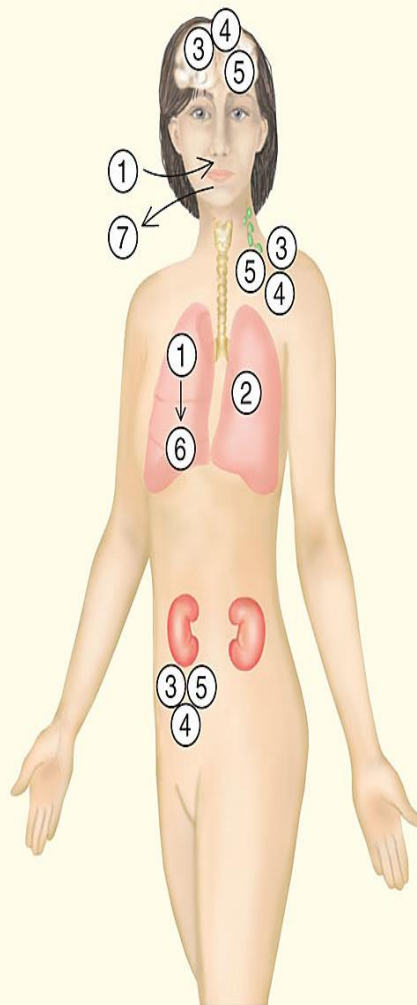
- Symptoms
 - Chronic illness
 - Symptoms include
 - Slight fever with night sweats
 - Progressive weight loss
 - Chronic productive cough
 - Sputum often blood streaked
- Causative Agent - *Mycobacterium tuberculosis*
 - Gram-positive cell wall type
 - Slender bacillus
 - Slow growing
 - Generation time 12 hours or more
 - Resists most prevention methods of control
- Pathogenesis
 - Usually contracted by inhalation of airborne organisms
 - Bacteria are taken up by pulmonary macrophages in the lungs
 - Resists destruction within phagocyte
- Pathogenesis
 - Organisms are carried to lymph nodes
 - About 2 weeks post infection intense immune reaction occurs
 - Macrophages fuse together to make large multinucleated cell
 - Macrophages and lymphocytes surround large cell
 - This is an effort to wall off infected tissue
 - Activated macrophages release into infected tissue
 - Causes death of tissue resulting in formation of “cheesy” material
- Epidemiology
 - Estimated 10 million Americans infected
 - Rate highest among non-white, elderly poor people
 - Small infecting dose
 - As little as ten inhaled organisms
 - Factors important in transmission
 - Frequency of coughing, adequacy of ventilation, degree of crowding
- Tuberculin test used to detect those infected
 - Small amount of tuberculosis antigen is injected under the skin
 - Injection site becomes red and firm if infected
 - Positive test does not indicate active disease
- Prevention
 - Vaccination for tuberculosis widely used in many parts of the world
 - Vaccine not given in United States because it eliminates use of tuberculin test as diagnostic tool

Tuberculosis - continued

- Treatment
 - Antibiotic treatment is given in cases of active TB
 - Two or more medications are given together to reduce potential antimicrobial resistance
 - Antimicrobials include
 - Rifampin and Isoniazid (INH)
 - Both target actively growing organisms and metabolically inactive intracellular organisms
 - Therapy is pronged
 - Lasting at least 6 months

Tuberculosis

- ① Airborne *Mycobacterium tuberculosis* bacteria are inhaled and lodge in the lungs.
- ② The bacteria are phagocytized by lung macrophages and multiply within them, protected by lipid-containing cell walls and other mechanisms.
- ③ Infected macrophages are carried to various parts of the body such as the kidneys, brain, lungs, and lymph nodes; release of *M. tuberculosis* occurs.
- ④ Delayed hypersensitivity develops; wherever infected *M. tuberculosis* has lodged, an intense inflammatory reaction develops.
- ⑤ The bacteria are surrounded by macrophages and lymphocytes; growth of the bacteria ceases.
- ⑥ Intense inflammatory reaction and release of enzymes can cause caseation necrosis and cavity formation.
- ⑦ With uncontrolled or reactive infection, *M. tuberculosis* exits the body through the mouth with coughing or singing.



Symptoms	Chronic fever, weight loss, cough, sputum production
Incubation period	2 to 10 weeks
Causative agent	<i>Mycobacterium tuberculosis</i> ; unusual cell wall with high lipid content
Pathogenesis	Colonization of the alveoli incites inflammatory response; ingestion by macrophages follows; organisms survive ingestion and are carried to lymph nodes, lungs, and other body tissues; tubercle bacilli multiply; granulomas form.
Epidemiology	Inhalation of airborne organisms; latent infections can reactivate.
Prevention and treatment	BCG vaccination, not used in the United States; tuberculin (Mantoux) test for detection of infection, allows early therapy of cases; treatment of all high-risk cases including young people with positive tests and individuals whose skin test converts from negative to positive. Treatment: two or more antitubercular medications given simultaneously long term, such as isoniazid (INH) and rifampin; DOTS.