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

**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 Zamanavir (nasal inhalers) are sometimes given early with mixed results
Influenza

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

Emergency Warning Signs of Children vs. Adults
• In Children
  o Fast breathing or trouble breathing
  o Bluish or gray skin color
  o Not drinking enough fluids
  o Severe or persistent vomiting
  o Not waking up or not interacting
  o Being so irritable that the child does not want to be held
  o Flu-like symptoms improve but then return with fever and worse cough
• In Adults
  o Difficulty breathing or shortness of breath
  o Pain or pressure in the chest or abdomen
  o Sudden dizziness
  o Confusion
  o Severe or persistent vomiting
  o 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 H1H1
• Antiviral Therapy
  o 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
  o At this time, treatment with Tamiflu® or Relenza® is recommended for all people with suspected or confirmed influenza who require hospitalization
  o 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
  - Otalgia 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 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, nysatagmus
- 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 of no fever
    - No perforation of eardrum, little or no membrane bulging
    - Well appearance
    - Mild pain
  - 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
  o Nasal decongestants, Augmentin
  o 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
  o Severe pain most noticeable with otorrhea
  o Mimics severe suppurative otitis media
• DX
  o Dx by x-rays
  o DD from otitis media by duration and intensity
• TX
  o 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

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

- **Symptoms**
  - 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

**Additional Information**

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.
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 sequelae

**Incubation period**
- 2 to 6 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
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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corynebacterium diphtheriae enters by inhalation.</td>
</tr>
<tr>
<td>2</td>
<td>Infection established in nasal cavity and/or throat.</td>
</tr>
<tr>
<td>3</td>
<td>Toxin released, pseudomembrane forms.</td>
</tr>
<tr>
<td>4</td>
<td>Toxin causes paralysis, damages heart muscle, kidneys, nerves.</td>
</tr>
<tr>
<td>5</td>
<td>Membrane may come loose and obstruct breathing.</td>
</tr>
<tr>
<td>6</td>
<td>Exit from body by respiratory secretions.</td>
</tr>
<tr>
<td></td>
<td>Symptoms</td>
</tr>
<tr>
<td></td>
<td>Incubation period</td>
</tr>
<tr>
<td></td>
<td>Causative agent</td>
</tr>
<tr>
<td></td>
<td>Pathogenesis</td>
</tr>
<tr>
<td></td>
<td>Epidemiology</td>
</tr>
<tr>
<td></td>
<td>Prevention and treatment</td>
</tr>
</tbody>
</table>
Whooping Cough

• Symptoms
  o Runny nose followed by bouts of uncontrollable coughing
    ▪ Termed paroxymal coughing
      • Severe cough can cause rupture of small blood vessels in the eyes
  o Coughing spasm followed by characteristic “whoop”
    ▪ Sound made by the forceful inspiration of air
  o Vomiting and seizure may occur

• Causative Agent
  o *Bordetella pertussis*
    ▪ Small
    ▪ Encapsulated
    ▪ Strictly aerobic
    ▪ Gram-negative
    ▪ Bacillus
    ▪ Does not survive long periods outside the host

• Pathogenesis
  o Enters respiratory tract with inspired air and attaches to ciliated cells
  o Organism colonizes structures of the upper and lower respiratory tract
  o Mucous secretion increases which causes ciliary action to decrease
    ▪ Cough reflex is only mechanism for clearing secretions

• Epidemiology
  o Spreads via infected respiratory droplets
  o Most infectious during runny nose period
    ▪ Number of organisms decrease with onset of cough
  o Classically disease of infants
    ▪ Milder forms are seen in older children and adults
  o Often overlooked as a persistent cold
    ▪ Fosters transmission

• Prevention
  o 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
  o Erythromycin is effective at reducing symptoms if given early
  o Antibiotic usually eliminates bacteria from respiratory secretions
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

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### TABLE 22.8 Pertussis

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Runny nose followed after a number of days by spasms of violent coughing; vomiting and possible convulsions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation period</td>
<td>7 to 21 days</td>
</tr>
<tr>
<td>Causative agent</td>
<td><em>Bordetella pertussis</em>, a tiny Gram-negative rod</td>
</tr>
<tr>
<td>Pathogenesis</td>
<td>Colonization of the surfaces of the upper respiratory tract and tracheobronchial system; ciliary action slowed; toxins released by <em>B. pertussis</em> cause death of epithelial cells and increased cAMP; fever, excessive mucus output, and a rise in the number of lymphocytes in the bloodstream result.</td>
</tr>
<tr>
<td>Epidemiology</td>
<td>Inhalation of infected droplets; older children and adults have mild symptoms.</td>
</tr>
<tr>
<td>Prevention and treatment</td>
<td>Acellular vaccines, for immunization of infants and children; erythromycin, somewhat effective if given before coughing spasms start, eliminates <em>B. pertussis</em>.</td>
</tr>
</tbody>
</table>
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 sacks 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
  - Emphyema
    - Prurulent infection in the pleural space
- Interstitial pneumonia
  - In the connective tissue between the alveoli with granular infiltration
- Lung abscess
  - Organisms destroy tissue and form pus abscess
- Emphyema
  - Prurulent 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
  - Staphlococci 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
  o Expectorates and lots of fluids
  o 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
  o A chronic destruction of the lung with scarring
  o Slow progressive lung damage and possible death
  o Systemic symptoms of wasting, fatigue, night sweats, appetite loss – used to be called consumption
- S & S
  o Cough, sputum, hemoptysis, TB spread to organs leads to destruction of organs and organ systems
- DX of classic triad
  o Lung infiltrate, calcified node enlargement, pleural effusion
- TX of TB
  o When it comes to treatment of TB, think slow
  o Slow growth of organisms, slow destruction of lung tissue, prolonged treatment and slow recovery
  o 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
- *Mycobacterium tuberculosis*; 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.