Infectious Diseases & Hematology

Section Two

Antibacterial, Antiviral & Antifungal Therapy

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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

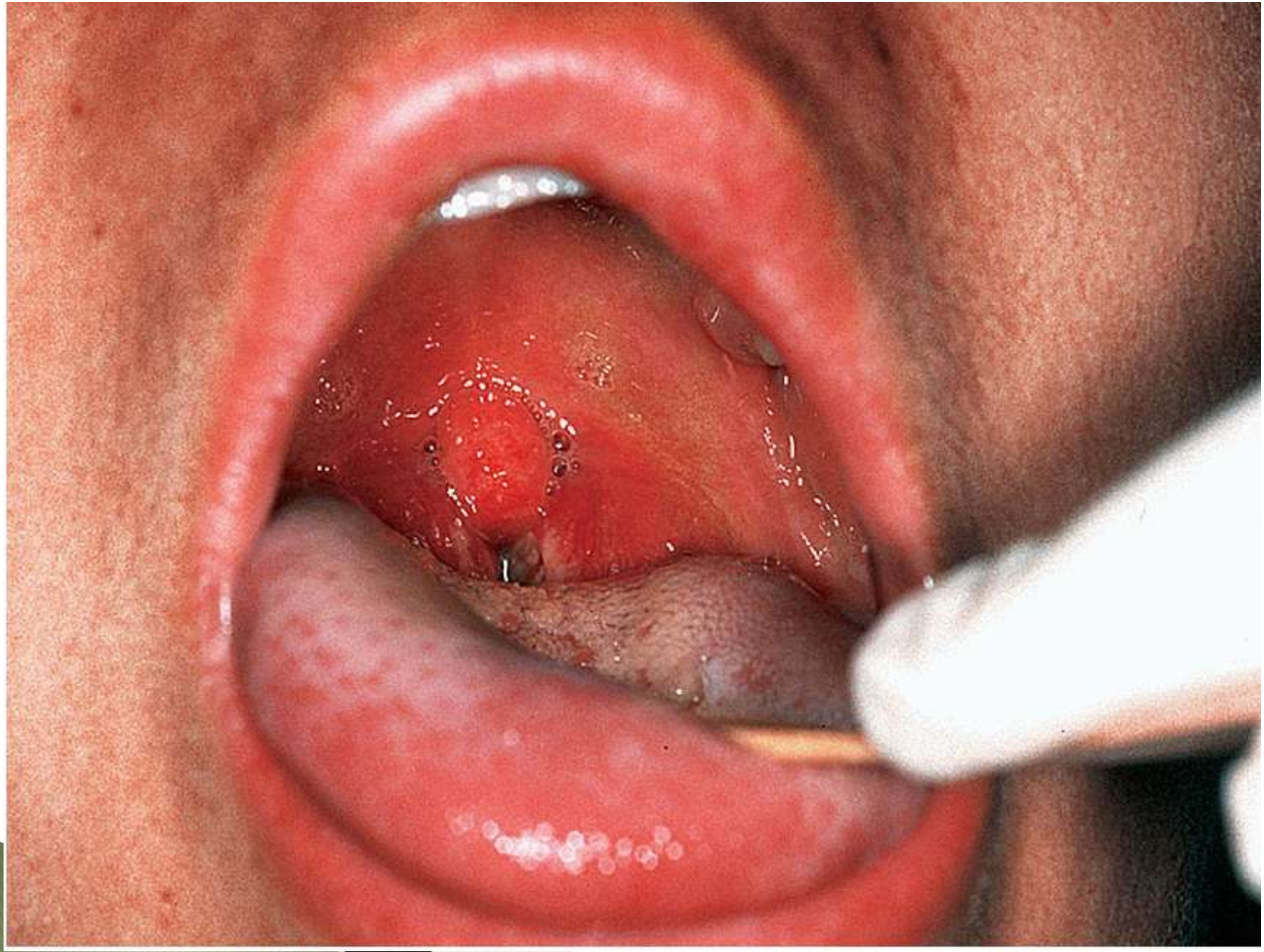
Narrow spectrum to broad spectrum

- 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, Tetracylcline, Doxycycline, Levofloxin
- Very broad-spectrum
  - Ticarcillin, Imipenim, Moxifloxacin

The cost of antibiotics

- Orals can cost as little as $5-$40 for 10 days
  - Tetracycline, Erythromyocin, 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

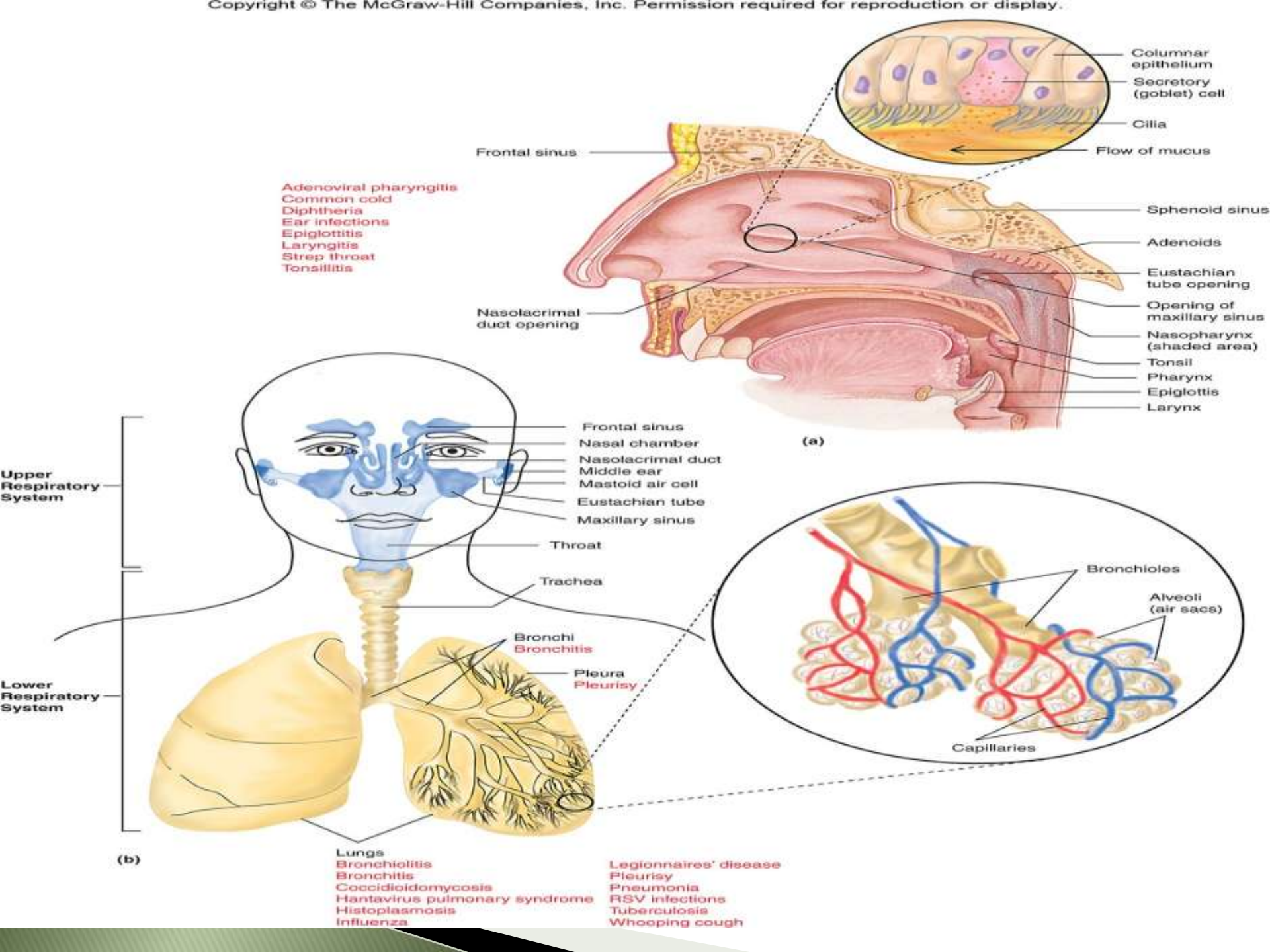


TABLE 22.1 Normal Microbiota of the Respiratory System

Genus	Characteristics	Comments
Staphylococcus	Gram-positive cocci in clusters	Commonly includes the potential pathogen *Staphylococcus aureus*, inhabiting the nostrils. Facultative anaerobes.
Corynebacterium	Pleomorphic, Gram-positive rods; non-motile; non-spore-forming	Aerobic or facultatively anaerobic. Diphtheroids include anaerobic and aerotolerant organisms.
Moraxella	Gram-negative diplococci and diplobacilli	Aerobic. Some microscopically resemble pathogenic *Neisseria* species such as *N. meningitidis*.
Haemophilus	Small, Gram-negative rods	Facultative anaerobes. Commonly include the potential pathogen *H. influenzae*.
Bacteroides	Small, pleomorphic, Gram-negative rods	Obligate anaerobes.
Streptococcus	Gram-positive cocci in chains	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).

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
  - 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
- Western 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

TABLE 22.11 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.

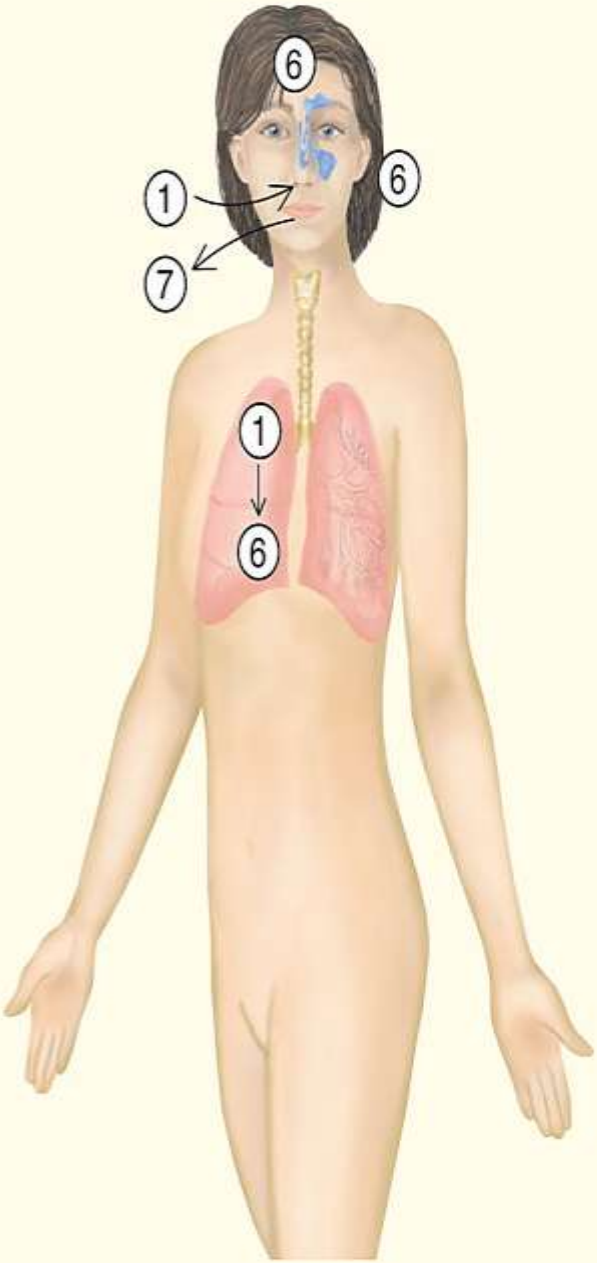
③ Host cell synthesis is diverted to synthesizing new virus.

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.

Bird Flu (H5N1 virus)

- First noted in China in1996 among birds
  - Has caused deaths of 140 million birds
  - Spread to humans via saliva, blood and contact with bird droppings – less then 150 human cases
  - 50% human fatality
  - Epidemiologists expect a genetic mutation with possible transmission from human to human
- S & S
  - Similar flu symptoms
- Diagnosis
  - Lab conformation
- TX
  - Tamiflu and Relenza
  - Best defense is vaccine

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

Symptoms of Seasonal and H1N1 Flu

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

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 H1H1

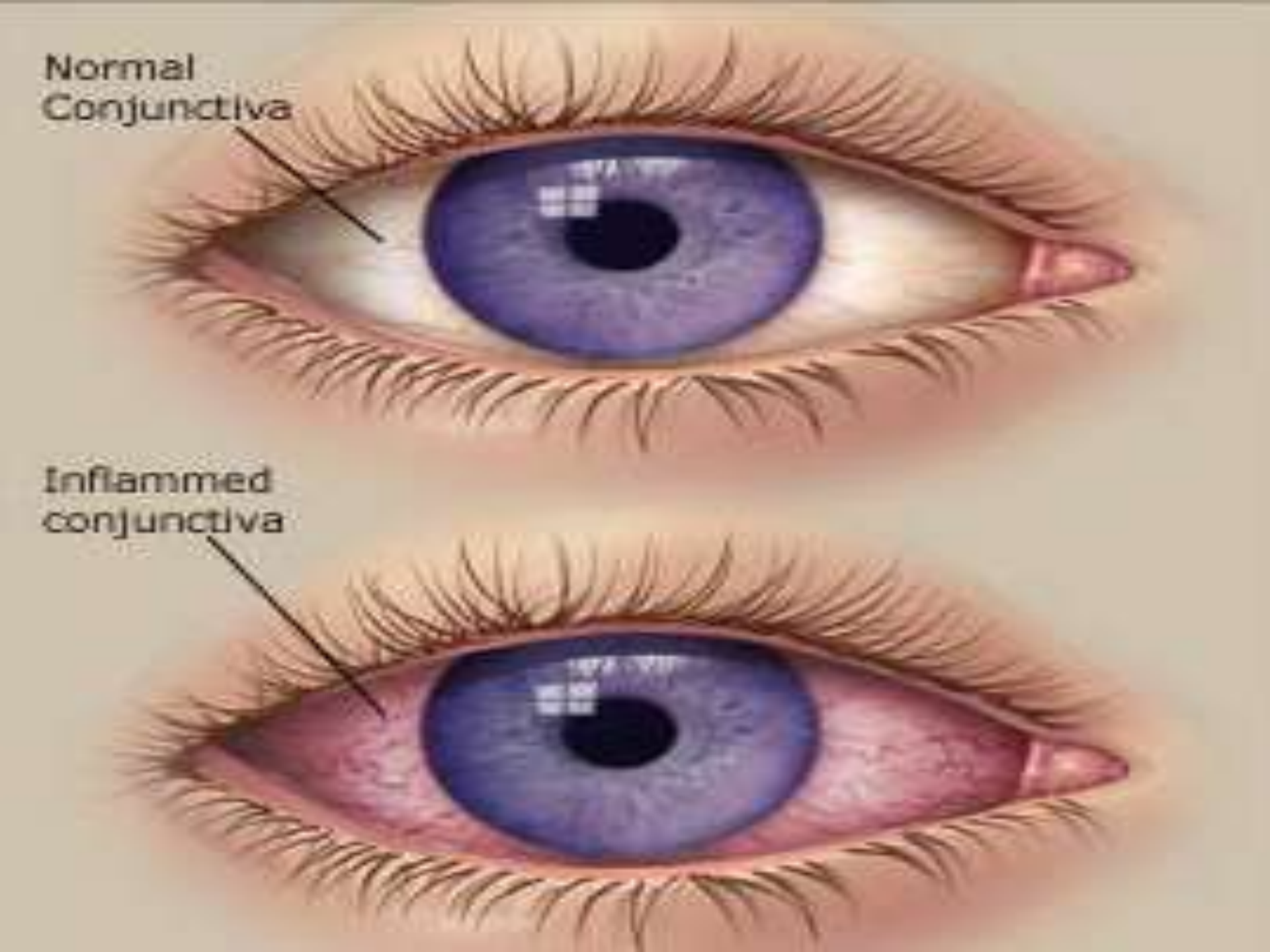
- Antiviral Therapy
  - Efficacy — Therapy should be started as soon as possible, since evidence of benefit is strongest for seasonal influenza when treatment is started within 48 hours of illness onset
  - At this time, treatment with oseltamivir (trade name Tamiflu®) or zanamivir (trade name Relenza®) 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

Pinkeye – Conjunctivitis

- Symptoms – Pinkeye
  - Increased tears and redness
  - Swelling eyelids
  - Sensitivity to bright light
  - Large amounts of pus

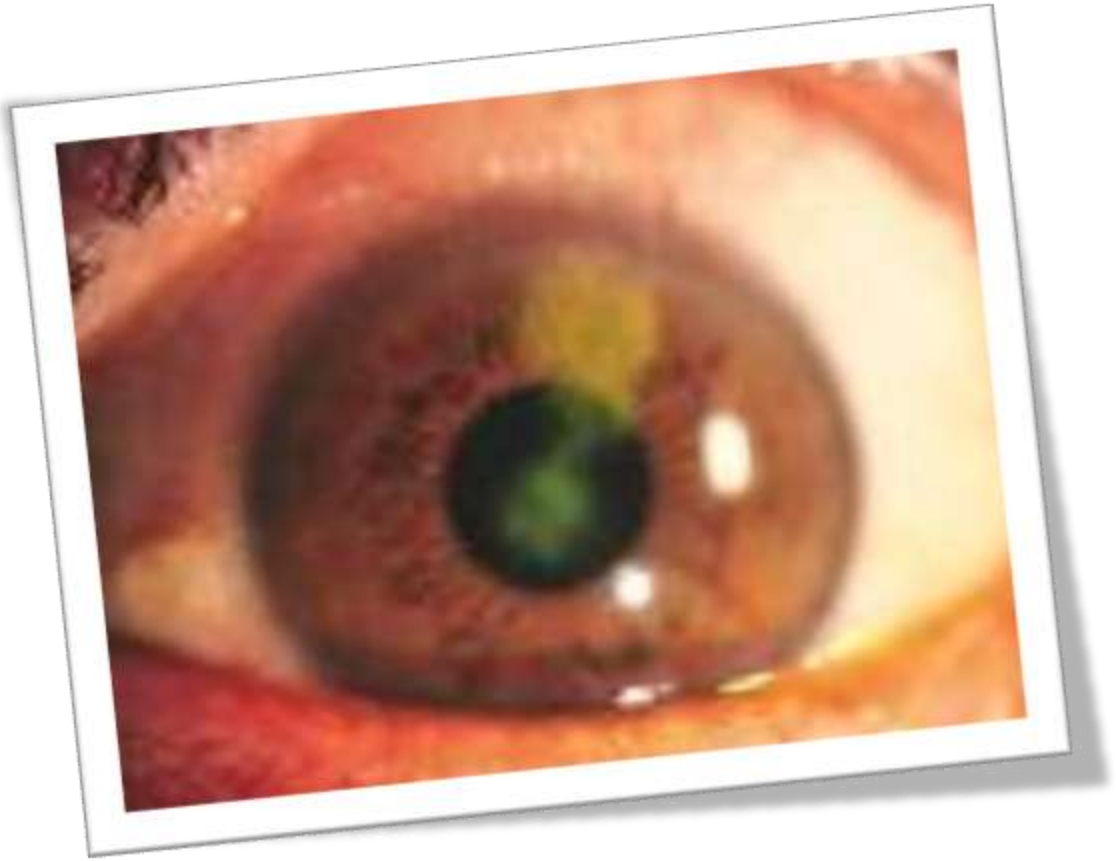

Normal
Conjunctiva
Inflammed
conjunctiva

- 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 eyedrops 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 bean autoimmune reaction and resolves in 2-3 years with considerable problems
  - Also caused by towel slapping in locker rooms

Herpes simplex keratitis



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 externa

Otitis Media

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

Otitis media

Normal Tympanic Membrane

Two Types of Otitis Media

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

Ped Infect Dis J 1992: 11 (Supp): 7 Bluestone CD Ten year review of otitis media pathogens
Ped Otolaryngol 1998: 118 837-843 Rosenfield R An evidence based approach to otitis media

Clinical Manifestations

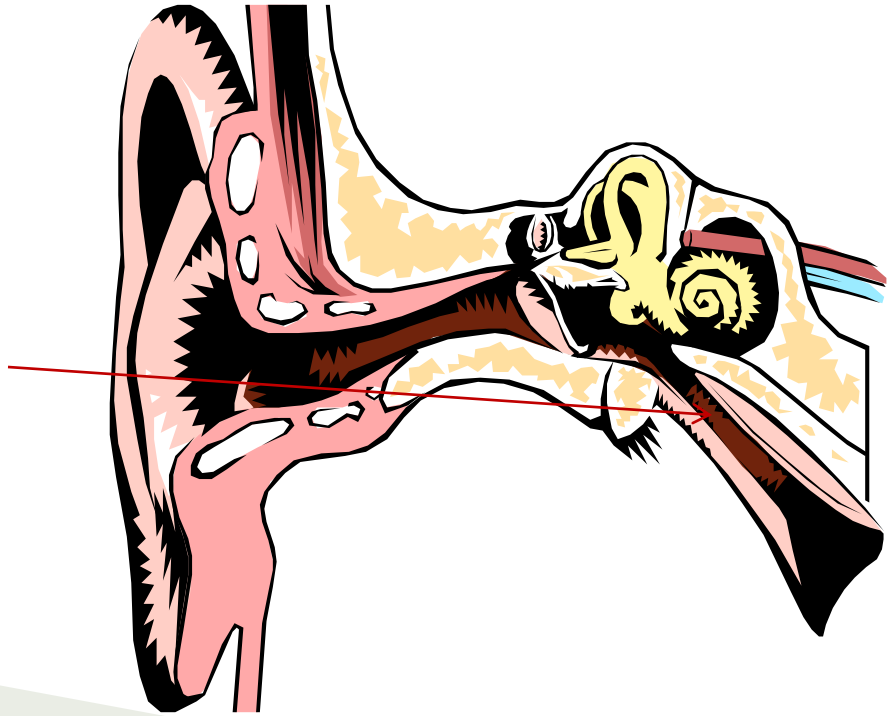
- Uncomplicated Otitis Media
  - Unilateral
  - Mild fever of no fever
  - No perforation of eardrum, little or no membrane bulging
  - Well appearance
  - Mild pain

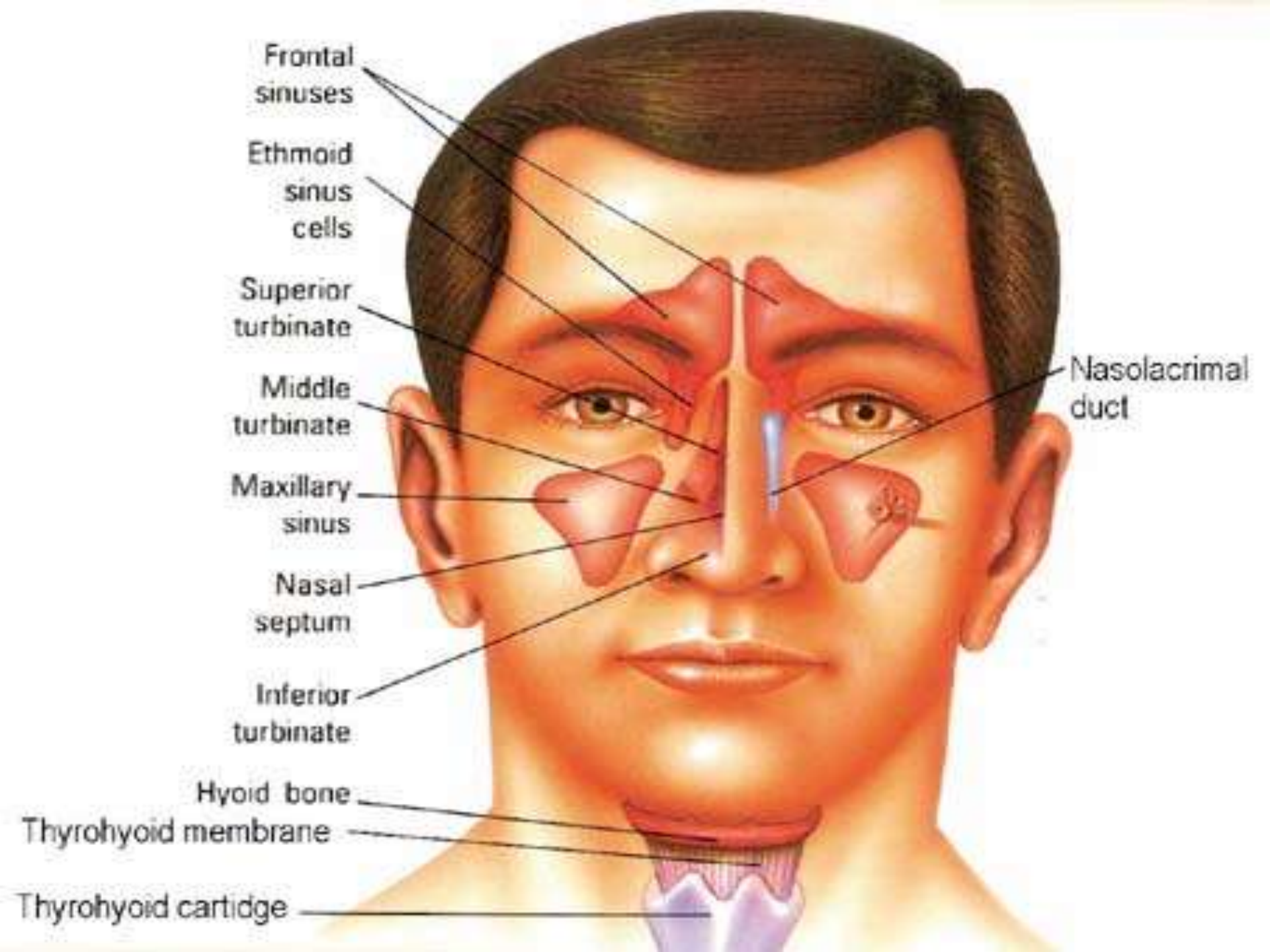
- Complicated Otitis Media
  - Perforation of tympanic membrane
  - Suppuration
  - Mastoiditis
  - High Fever
  - Sick appearance
  - Severe pain

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

Eustachian (auditory) tube



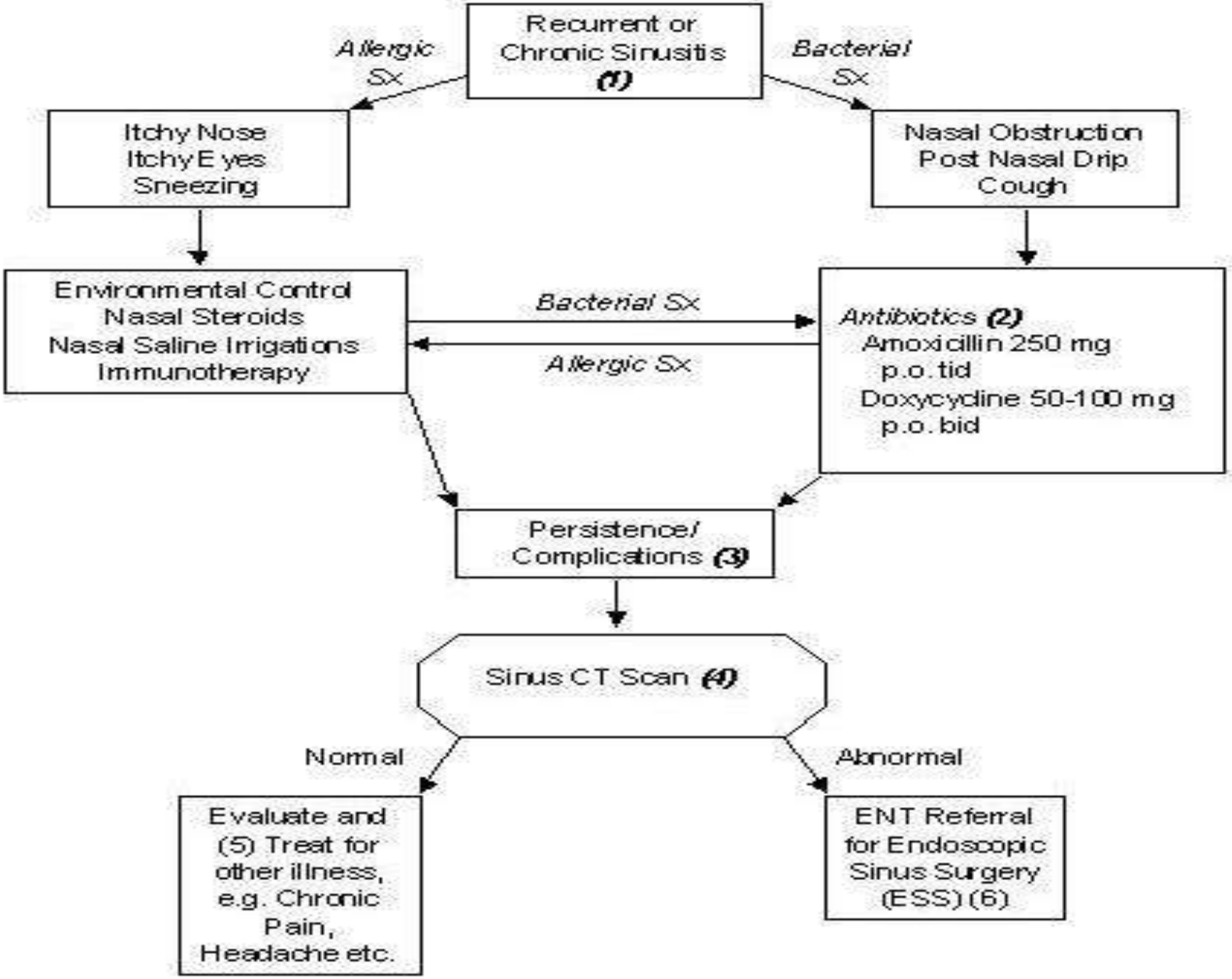

Frontal sinuses
Ethmoid sinus cells
Superior turbinate
Middle turbinate
Maxillary sinus
Nasal septum
Inferior turbinate
Hyoid bone
Thyrohyoid membrane
Thyrohyoid cartidge
Nasolacrimal duct

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

Sinusitis

- Prevention
  - There are no proven preventative measures for sinusitis
- Treatment is directed at support care
  - Nasal decongestants, Augmentin
  - Decongestants and antihistamines are generally discouraged
    - Ineffective and can be harmful


Recurrent or Chronic Sinusitis (1)
Allergic Sx
Bacterial Sx
Itchy Nose
Itchy Eyes
Sneezing
Nasal Obstruction
Post Nasal Drip
Cough
Environmental Control
Nasal Steroids
Nasal Saline Irrigations
Immunotherapy
Bacterial Sx
Allergic Sx
Antibiotics (2)
Amoxicillin 250 mg p.o. tid
Doxycycline 50-100 mg p.o. bid
Persistence/ Complications (3)
Sinus CT Scan (4)
Normal
Abnormal
Evaluate and (5) Treat for other illness, e.g. Chronic Pain, Headache etc.
ENT Referral for Endoscopic Sinus Surgery (ESS) (6)

Mastoiditis

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

Mastoiditis

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

Adenoviral Pharyngitis

- 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

Adenoviral Pharyngitis

- 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

- 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

Adenoviral Pharyngitis

- 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

- Acute Pharyngitis

Pharyngitis Treatment

Table 2. Antibiotics and Dosing for Recurrent Episodes of Pharyngitis

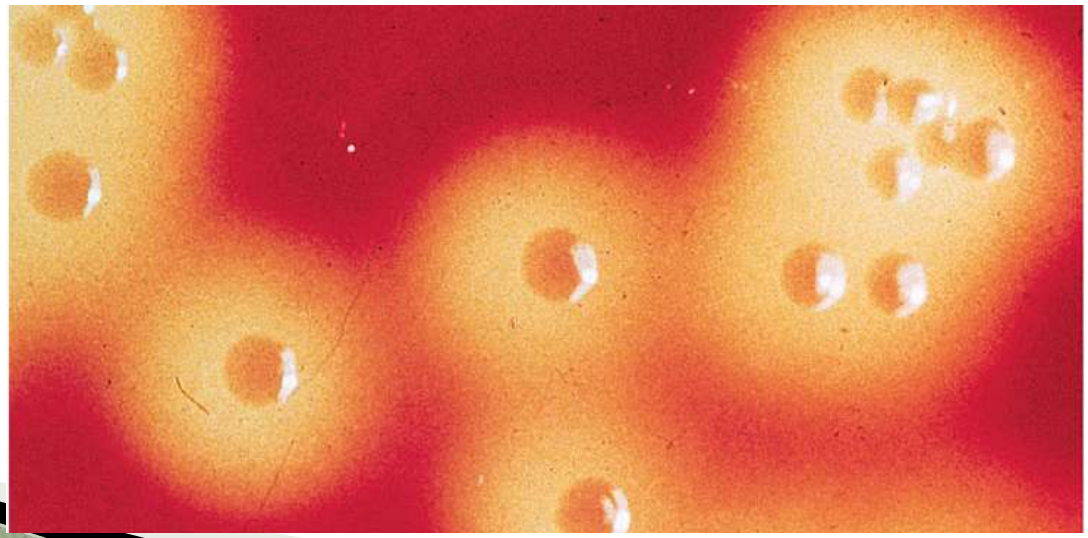
Drug	Adult Dosage	Pediatric Dosage	Duration
Clindamycin	600 mg orally divided in 2-4 divided doses	20-30 mg/kg/day in 3 divided doses (max:1.8 g/day)	10 days
Amoxicillin-clavulanate	500 mg twice daily	40 mg/kg/day in 3 divided doses	10 days
Penicillin benzathine	1.2 million units intra-muscularly for 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

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

Streptococcal Pharyngitis

- 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

- 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

Streptococcal Pharyngitis

- 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


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TABLE 22.3 Strep Throat (Streptococcal Pharyngitis)

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

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

Symptoms go away.

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

Late complications appear:

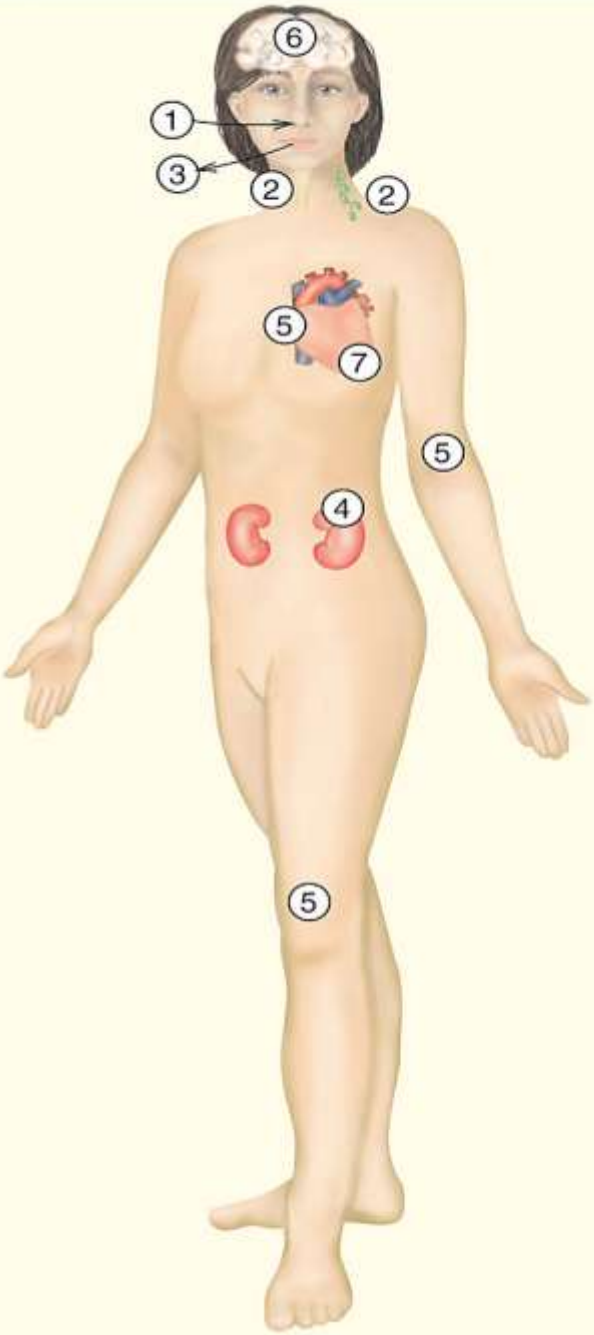
④ glomerulonephritis

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.

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 to1970

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

- 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

Common Cold

- 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

Common 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

Common Cold

- 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


You've got the Uncommon Cold.
Nicholson


ACCORDING TO MEDICAL SCIENCE, BRANDY CAN'T CURE THE COMMON COLD!
NEITHER CAN MEDICAL SCIENCE!
PHARMACY
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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.

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
- 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
  - Prurulent infection in the pleural space
- Nodular lung infections
  - TB, coccidiomycosis and histoplasmosis cause nodular infiltrations

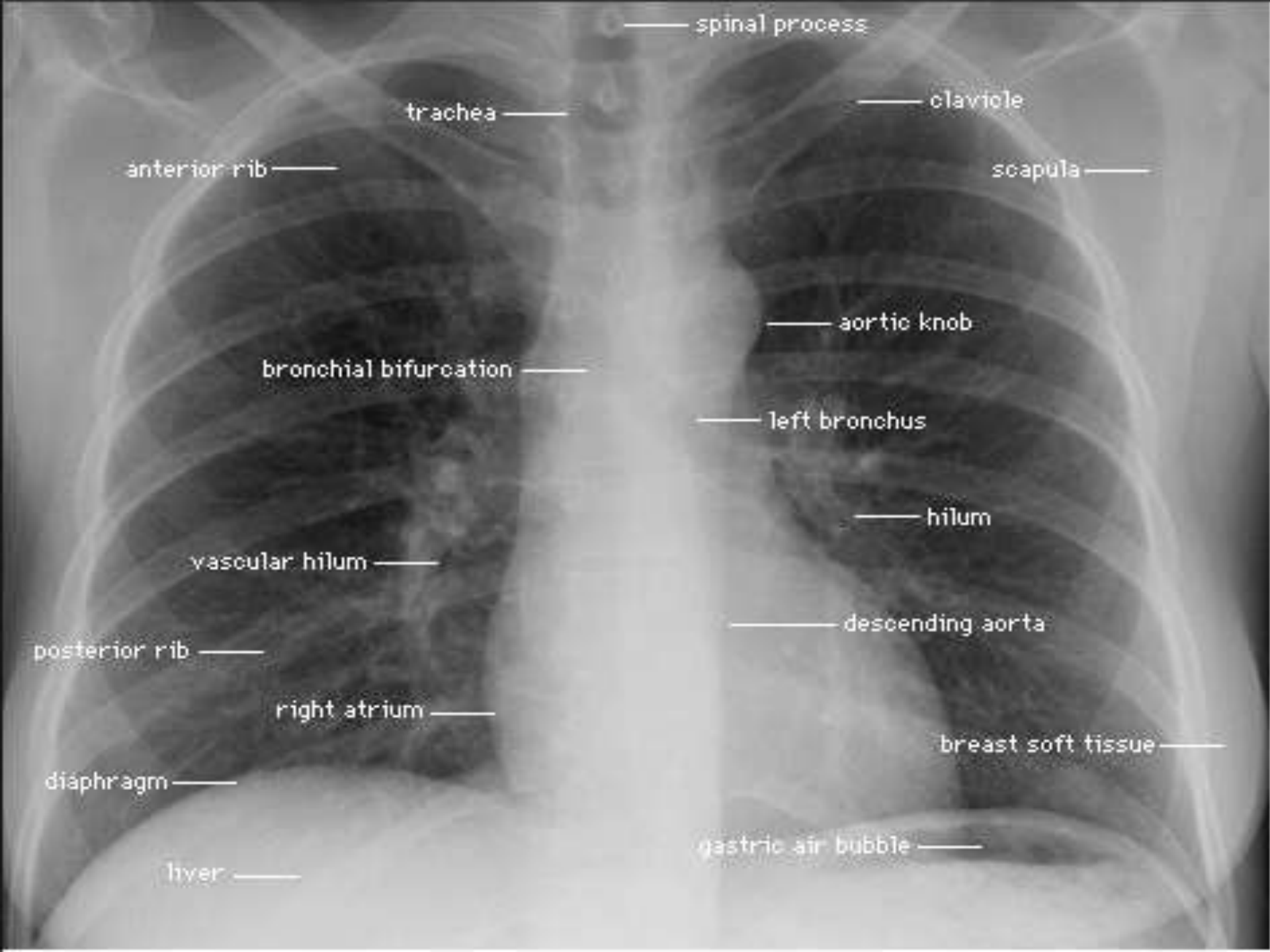
Dx according to where the pneumonia was acquired

- Community acquired
  - Acquired anywhere in the community, but not in a hospital
- Nosocomial
  - Acquired in a hospitalized setting

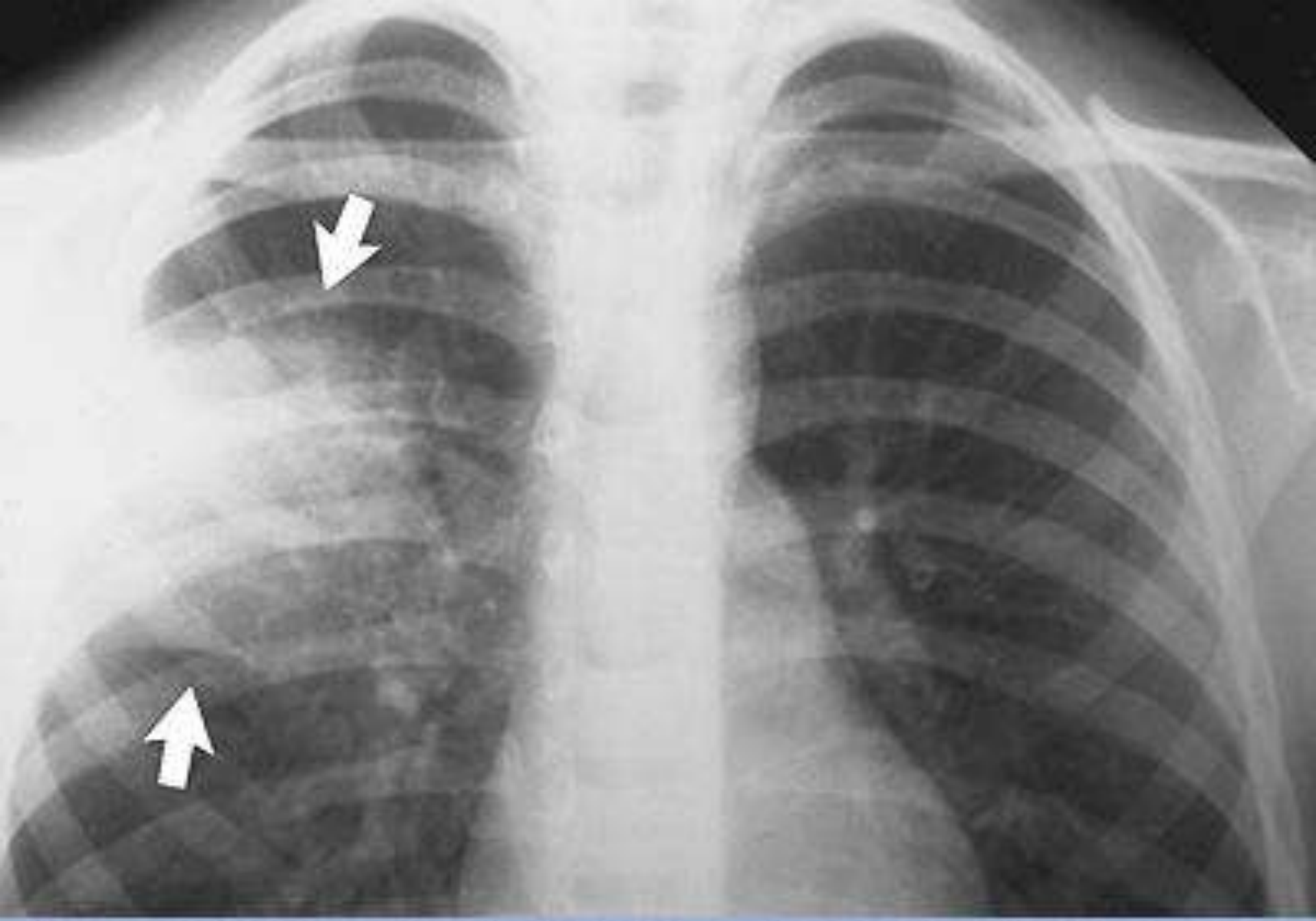
Dx according to etiologic agent

- 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
- 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
  - Expectorates and lots of fluids
  - Codeine for severe pain


spinal process
trachea
clavicle
anterior rib
scapula
aortic knob
bronchial bifurcation
left bronchus
hilum
vascular hilum
descending aorta
posterior rib
right atrium
breast soft tissue
diaphragm
gastric air bubble
liver

Pnuemonia




TUBERCULOSIS

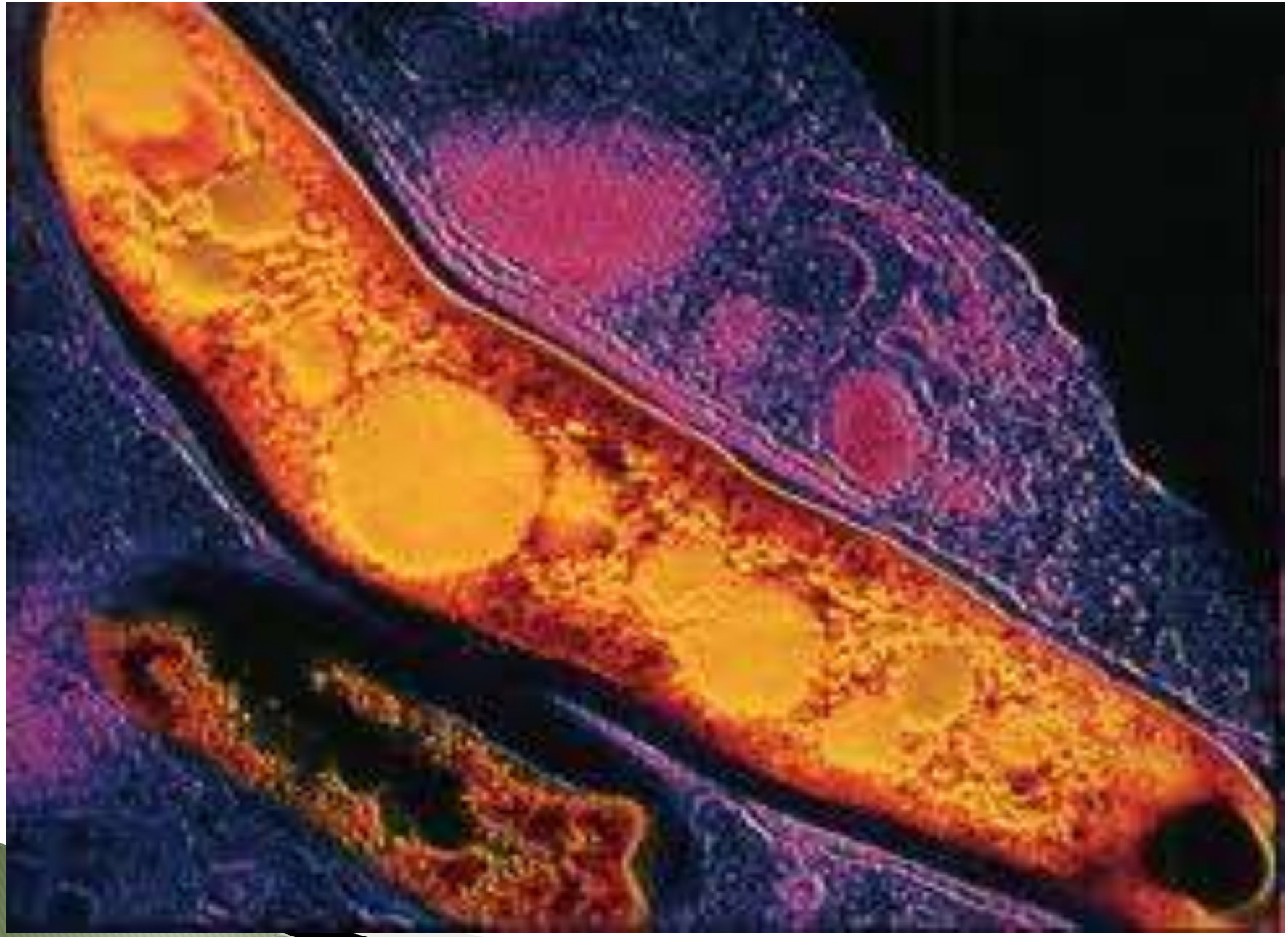
Tuberculosis – TB

- 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

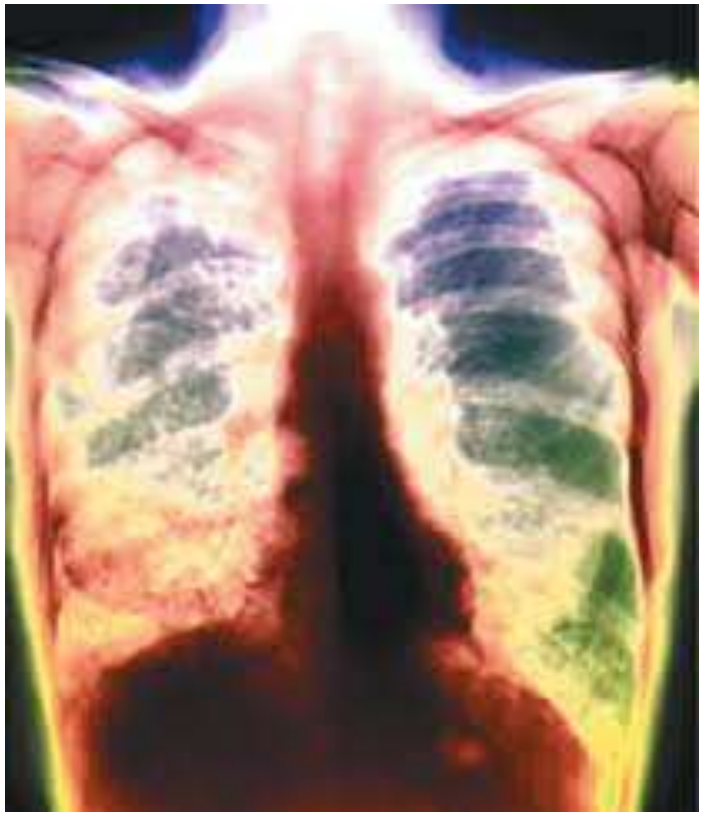
Tuberculosis

- 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



Tuberculosis

- Pathogenesis
  - Usually contracted by inhalation of airborne organisms
  - Bacteria are taken up by pulmonary macrophages in the lungs
  - Resists destruction within phagocyte

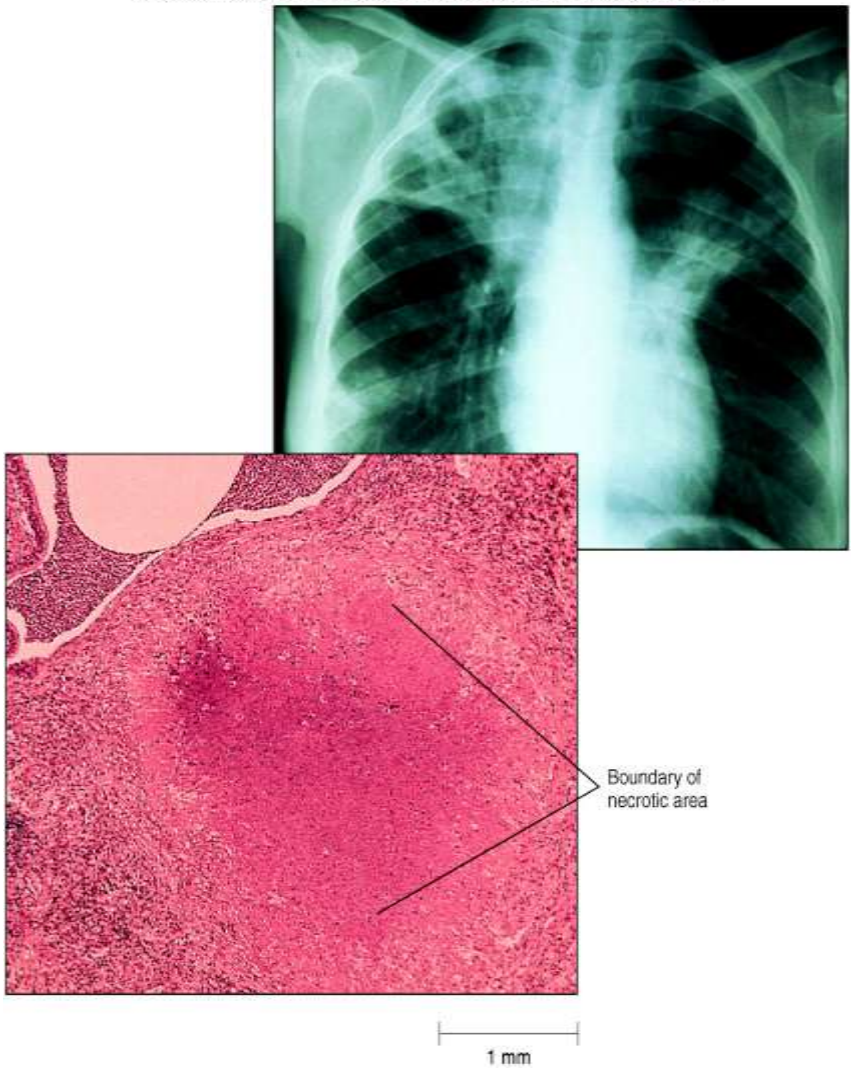


Tuberculosis

- 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

Tuberculosis

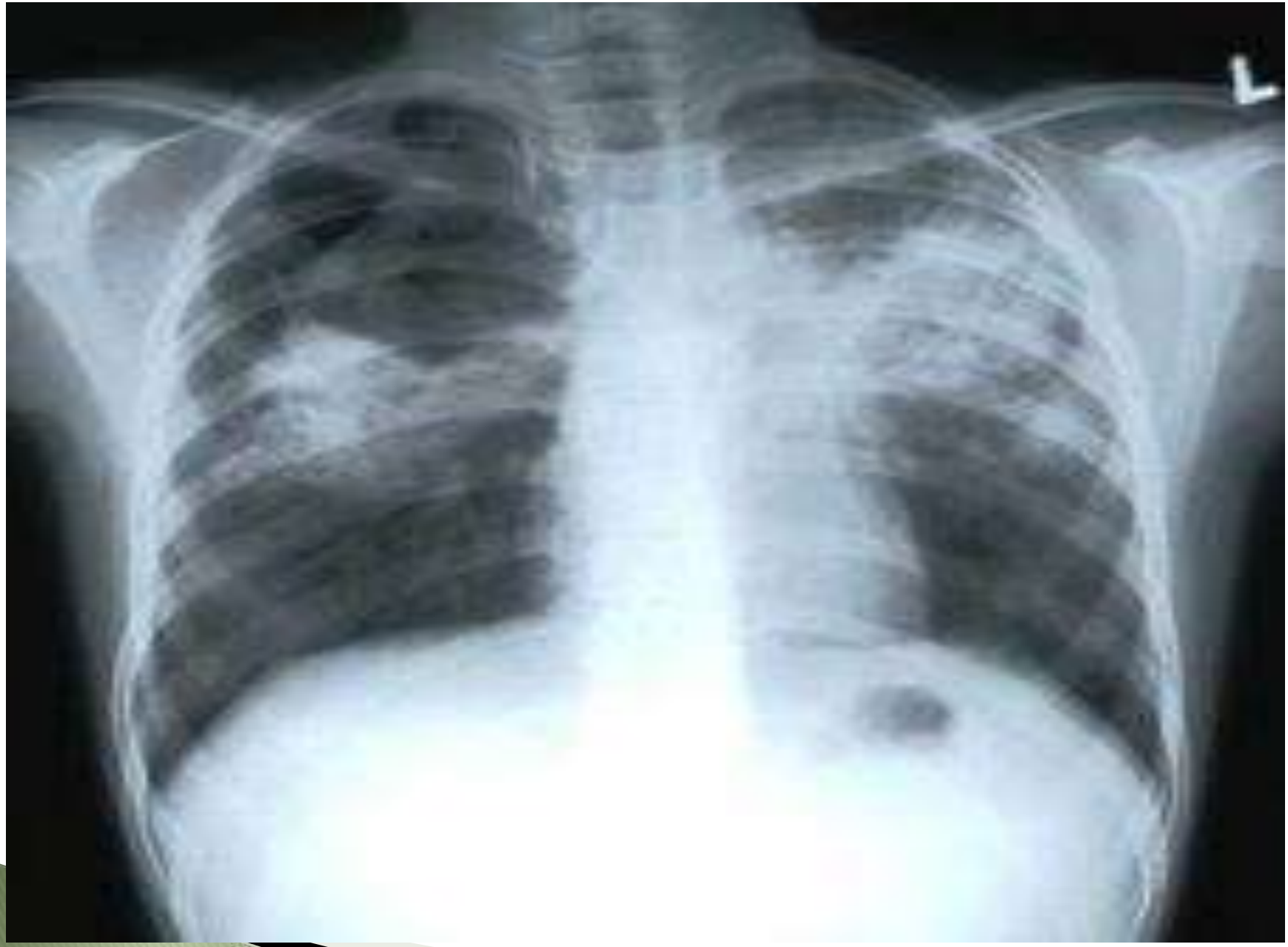
- Epidemiology
  - Estimated 10 million Americans infected
    - Rate highest among non-white, elderly poor people
  - Small infecting dose
    - As little as ten inhaled organisms
  - Factors important in transmission
    - Frequency of coughing, adequacy of ventilation, degree of crowding



Tuberculosis

- Epidemiology
  - 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
- 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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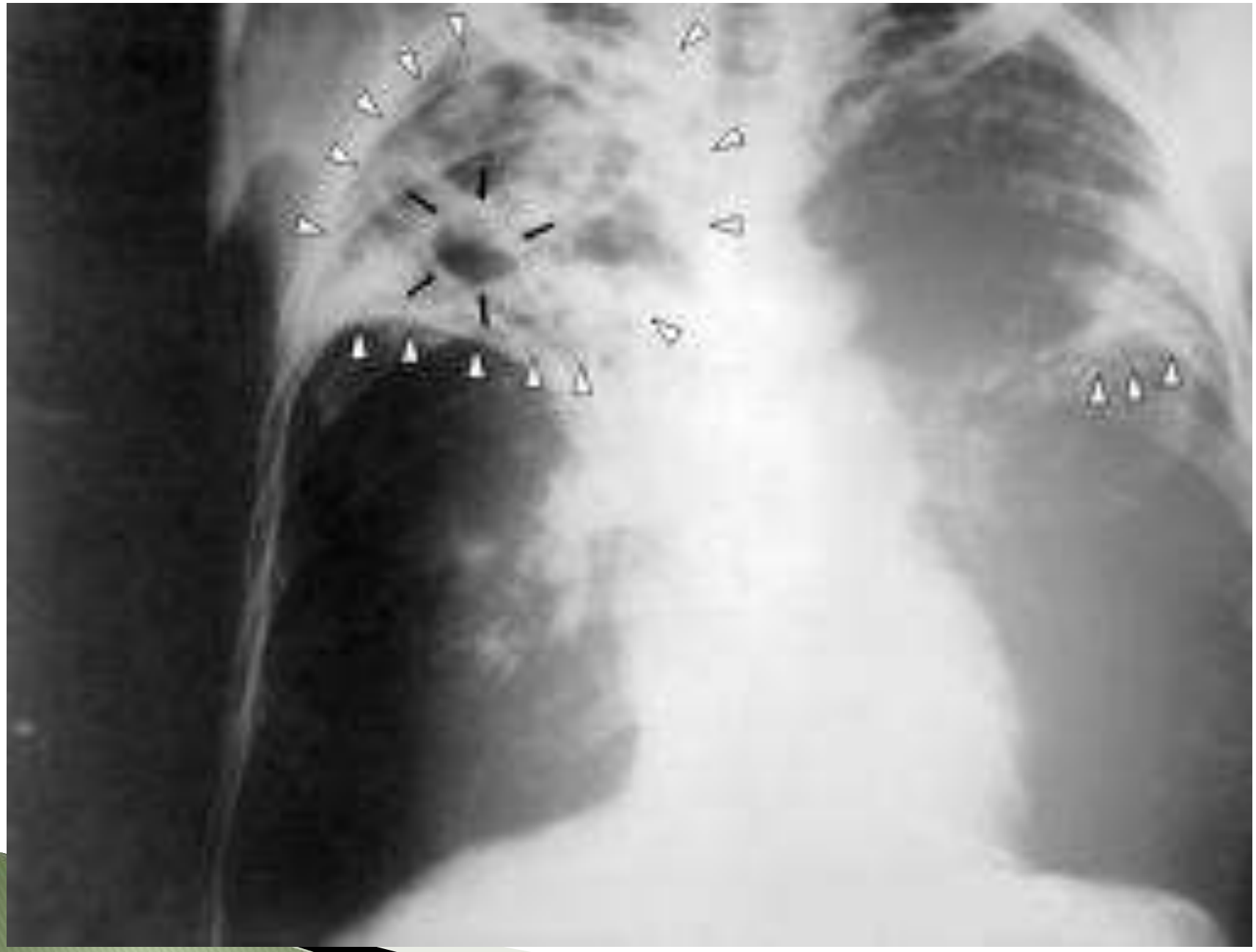


TABLE 22.9 Tuberculosis

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.

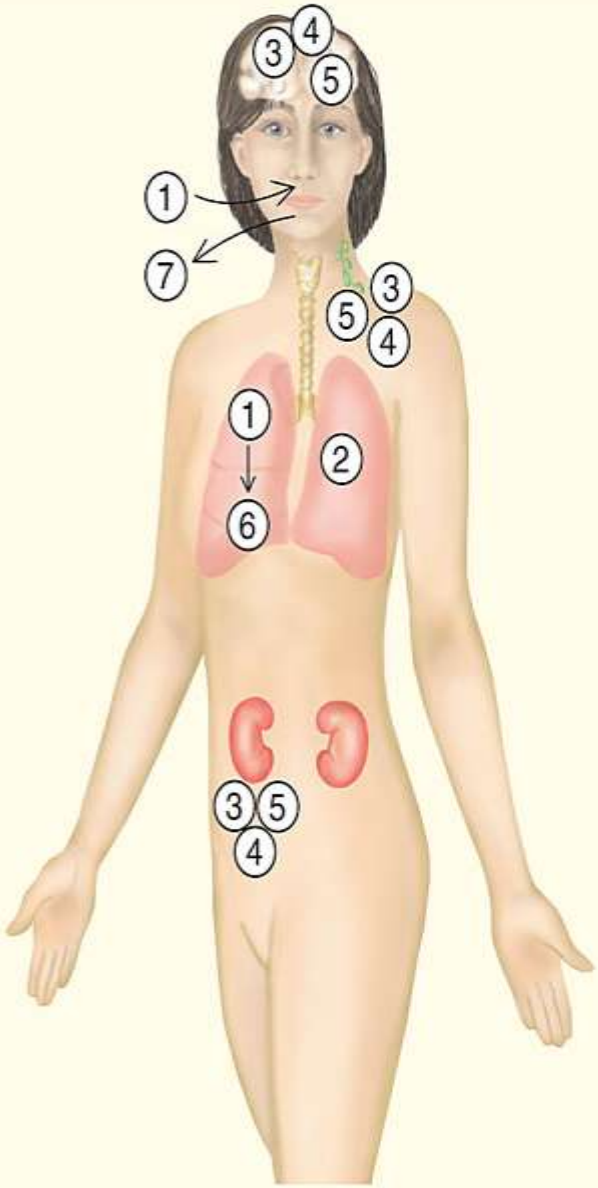
③ Infected macrophages are carried to various parts of the body such as the kidneys, brain, lungs, and lymph nodes; release of *M. tuberculosis* occurs.

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.

Cardiovascular Infections

Pericarditis

- Three forms of pericarditis:
- Viral pericarditis
  - Usually self-limiting and not serious
  - Classic friction rub on auscultation
- Bacterial pericarditis
  - Usually hematogenous in origin
- Noninfectious autoimmune pericarditis
  - Most common form – seen in RA, SLE, or autoimmune disease

- S & S
  - Substernal friction rub usually severe
  - Heart failure can occur from fluid buildup which causes cardiac tamponade
- DX
  - **Friction rub**
  - ECG and echocardiography changes
- TX
  - IV antibiotics
  - Pericardiocentesis to remove purelent fluid

  - Pericarditis Disease Health Byte

Endocarditis

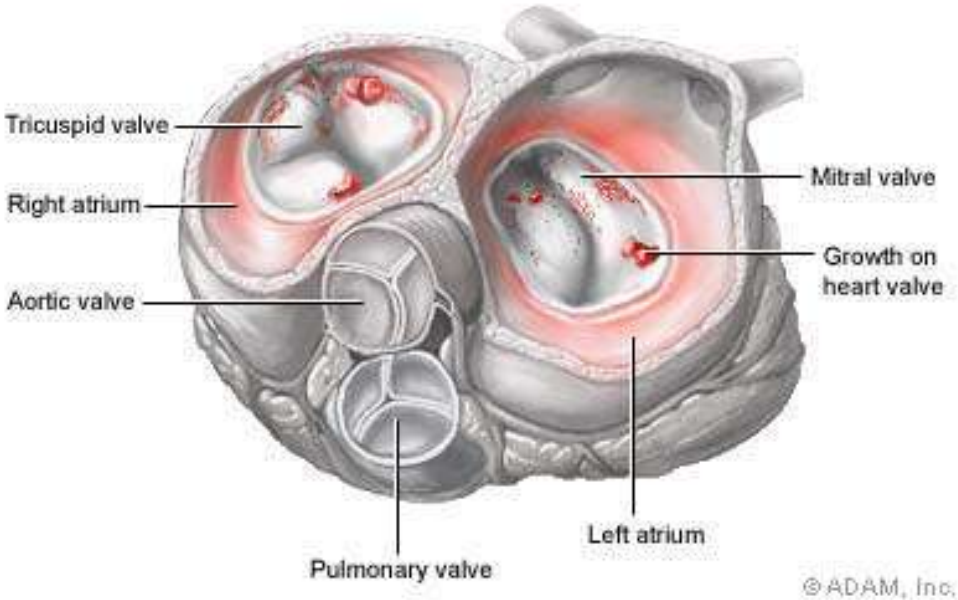
- Bacterial infection of one or more heart valves
  - Damaged valves attract bacteria which is called vegetative damage
  - Dental work may cause temporary bacteremia, which can lodge on the damaged valves
  - Upper airway procedures, GI procedures and urological procedures can also cause
- S & S
  - Low grade fevers, night sweats, fatigue, malaise, weight loss
  - Back pain with fever is classic finding

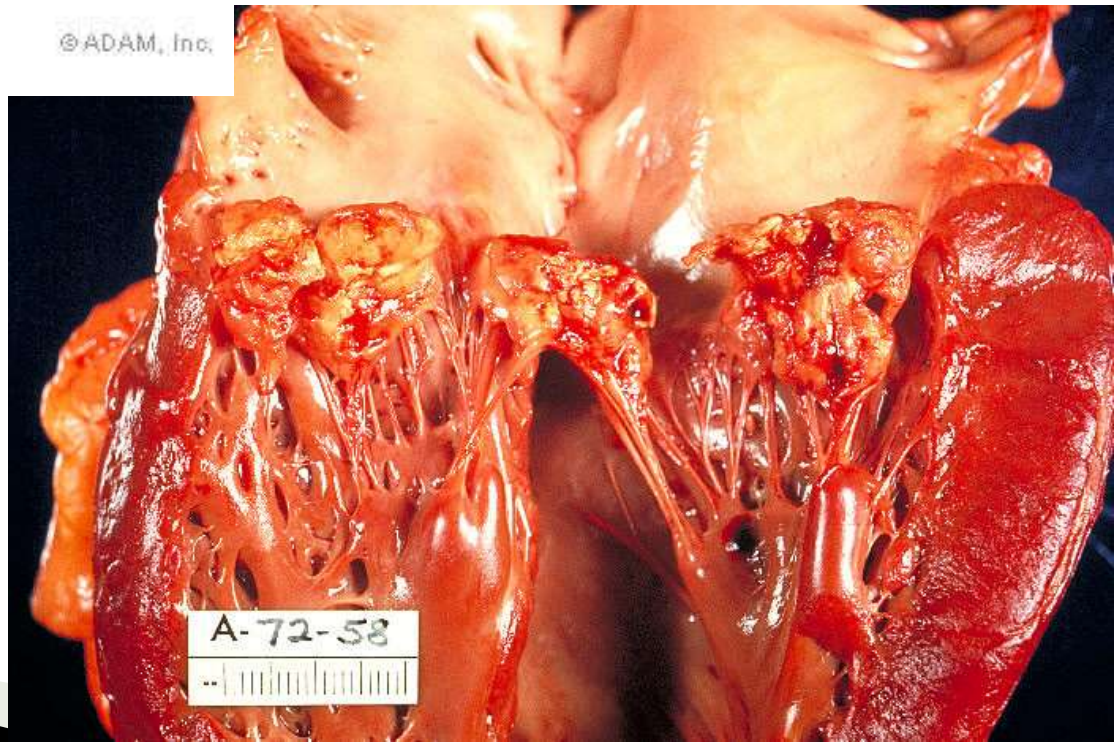
Endocarditis

- Diagnosis
  - Murmurs
  - Splinter hemorrhages under nails, retinal and conjunctival hemorrhages, petechiae
  - Mini strokes when bacteria reach the brain
  - Dx with two cultures and ECHO
- TX
  - Powerful IV antibiotics
  - Surgical debridement and abscess drainage
  - Occasional valvoplasty needed

Endocarditis

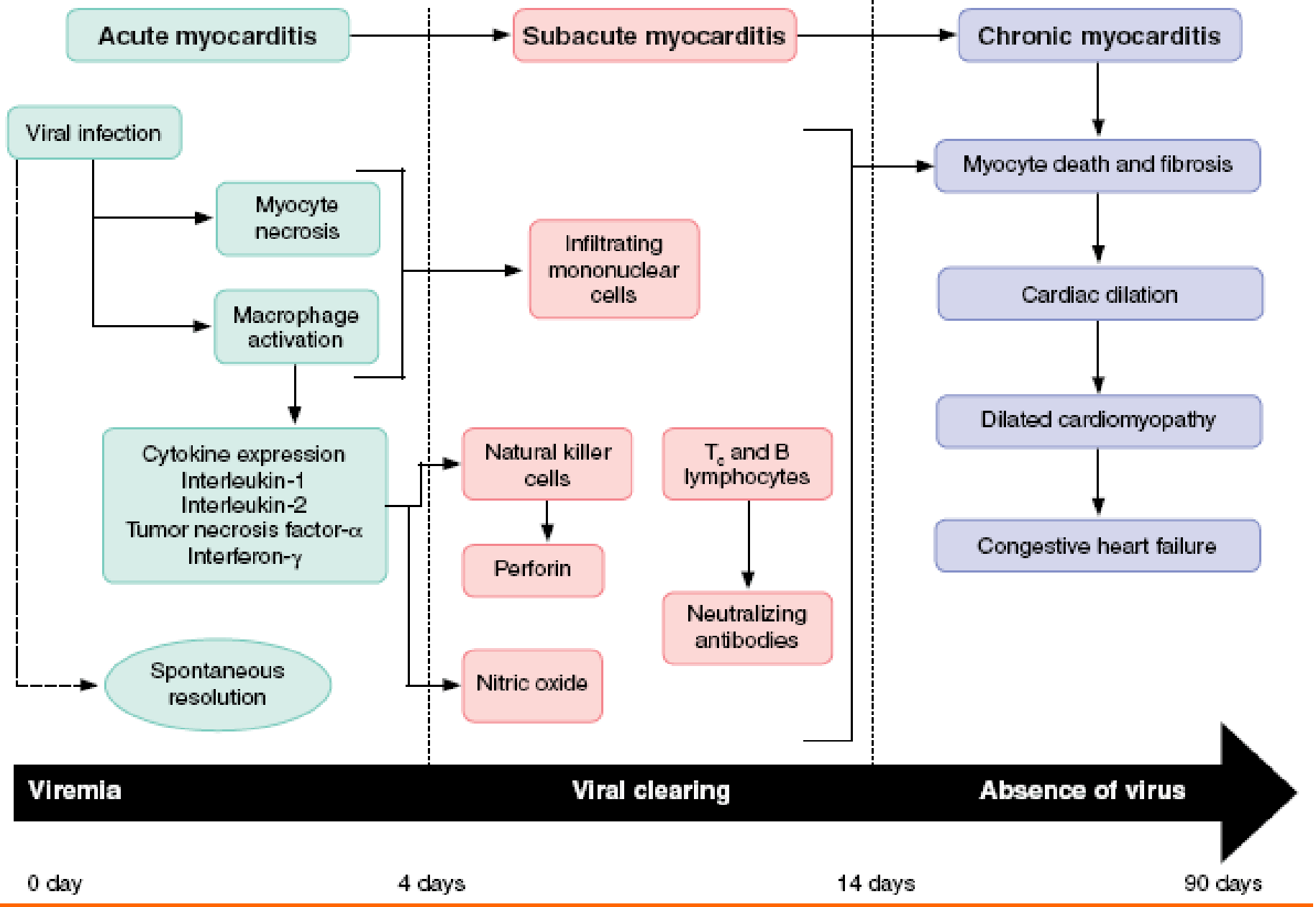
Infective endocarditis is an infection of the heart chambers or valves





Myocarditis

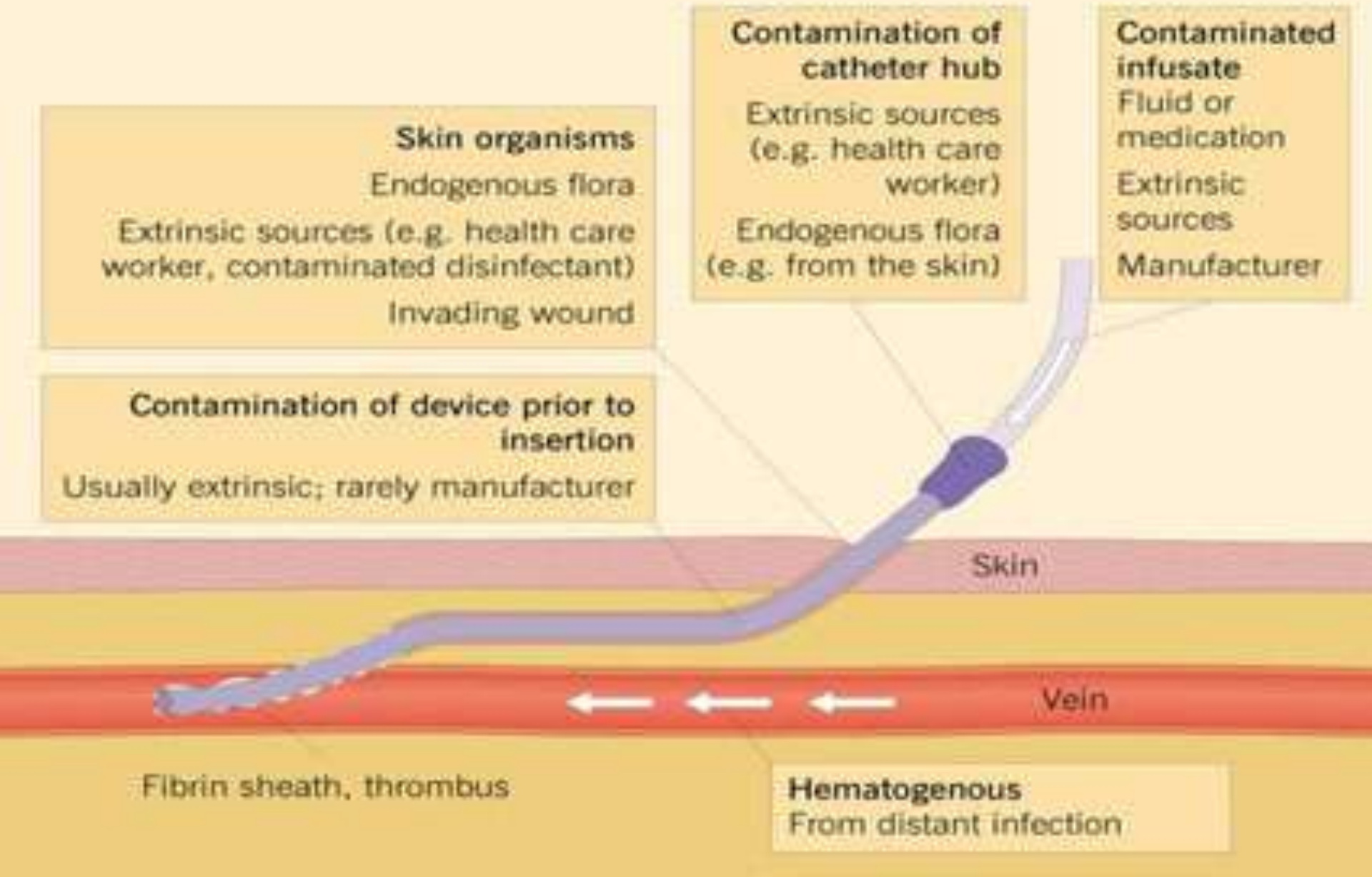
- Located in the heart muscle or connective tissue
- Can be an autoimmune inflammation
- Can be an infection – which is always viral
- S & S
  - Fever, profound weakness, chest pain, tachycardia, and possible onset of heart failure
- DX
  - ECG, elevated CRP & ESR, biopsy
- TX
  - Corticosteroids and antibiotics



Catheter Infections

- More then 200,000 hospital-based blood stream infections annually occur
  - Most are due to long term catheter placement
- All are life threatening
- S & S
  - Fever, chills, malaise and purulent discharge from catheter site
- DX
  - Suspected if catheter in place with fever & tenderness
- TX
  - IV vancomycin and catheter removal

POTENTIAL ROUTES OF INFECTION



Nervous System Infections

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- All nervous system infections are red flag events and are true emergencies
- Because of the confined nature of the CNS, inflammation causes significant problems
- Types of CNS infections
  - Encephalitis
  - Brain abscesses
  - Myelitis
  - Meningitis

Encephalitis

- Acute brain infection with high mortality
- Three viral causes
  - Spread by mosquitoes
  - Spread from human to human
    - Mumps, measles, Epstein-Barr, herpes zoster
  - Spread from animal bite
- Signs and Symptoms
  - Severe headache, fever, ataxia, seizures cortical dysfunction, motor changes, hallucinations
- Diagnosis – usually presumptive with symptoms
  - CT, MRI, LP
- Treatment
  - No standard tx – 50-60% mortality

TABLE 27.7 Epidemic Viral Encephalitis

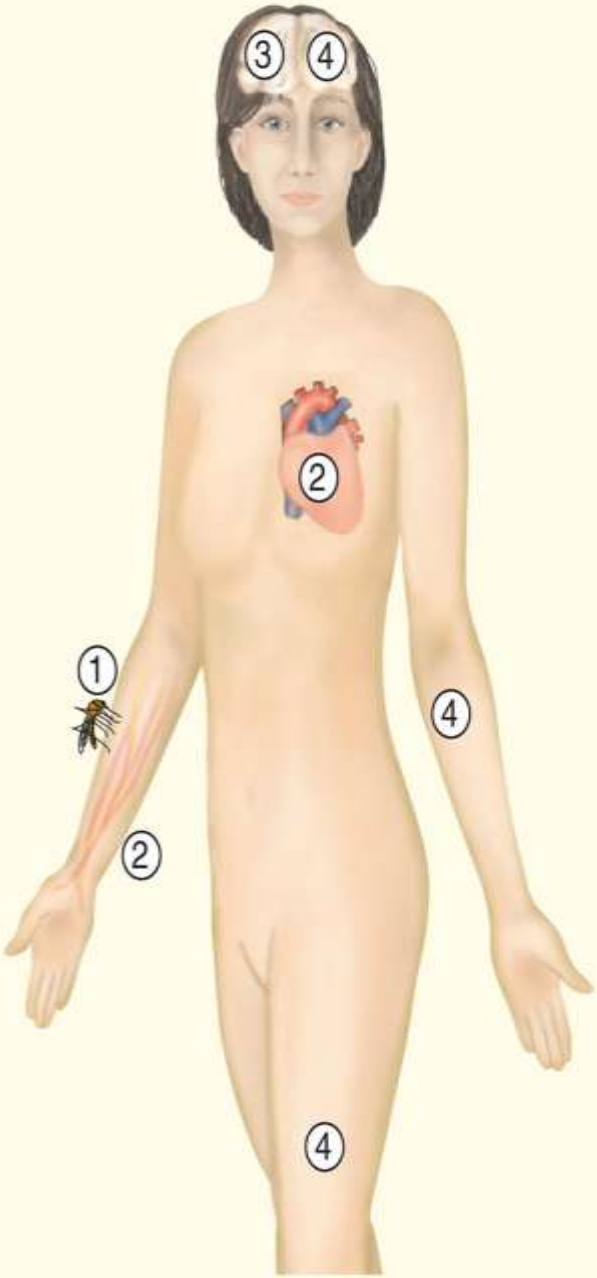
① Infected mosquito introduces encephalitis virus.

② Virus multiplies locally, establishes brief low-level viremia.

③ Virus crosses blood-brain barrier and preferentially attacks the brain.

④ Destruction of brain tissue causes death or permanent disabilities such as emotional instability, mental retardation, paralysis of face, arm, leg.

⑤ Due to brief viremia, there is no exit for the virus, thus humans are the final host.



Symptoms	Abrupt onset, fever, headache, vomiting, disorientation, paralysis, seizures, deafness, coma
Incubation period	First symptoms within a few days; encephalitic symptoms often within the first week
Causative agent	Usually caused by one of four arboviruses, LaCrosse, St. Louis, western equine, or eastern equine
Pathogenesis	Replication of virus at the site of the mosquito bite, further replication in lymph nodes, then viremia that seeds brain tissue. Nerve cells in the brain invaded, destroyed. Process halted by neutralizing antibody.
Epidemiology	Viruses transmitted to humans from birds or rodents by mosquitoes.
Prevention and treatment	Chicken sentinels to warn of arbovirus epidemics. Insecticides and other anti-mosquito preventive measures. No accepted treatment for arboviral encephalitis.

Brain Abscesses

- Etiology
  - Most commonly caused by frontal sinus infections or mastoiditis
  - Can also be sequeala of brain surgery.
- Signs and symptoms
  - Fever, drowsiness, altered judgment, mutism, other neurological signs and symptoms
- Diagnosis with CT and MRI
- Treatment
  - Neurosurgical drainage and 6-8 weeks IV antibiotics

Myelitis

- Infection or inflammation of the spinal cord
- In the past, this was commonly caused by the polio virus and was called poliomyelitis
  - Prior to 1950 Salk and Sabine vaccine
- The cytomegalic virus can cause myelitis in AIDS patients – very rare

Bacterial Menengitis

- Etiology
  - Very dangerous infection, usually in young children – can be fatal in minutes to hours
  - Most caused by bacteremia – bacteria in blood
    - Bacteria from ENT infections
    - Head trauma may cause infection
- Signs and symptoms
  - Severe headache, nuchal rigidity, vomiting, high fever, loss of orientation or consciousness, rashes, bone-shaking chills
- Treatment
  - Should start within 30 minutes – ICU IV antibiotics

Meningococcal Meningitis

- Symptoms
  - Mild cold followed by onset of throbbing headache
  - Fever
  - Pain and stiffness of neck and back
  - Nausea and vomiting
  - Deafness and alteration in consciousness may appear progressing to coma

- Small hemorrhages called petechiae may appear on skin
- Infected person may develop shock and die within 24 hours
  - Usually progression of disease is slower allowing time for treatment

Meningococcal Meningitis

© Kenneth Greer/Visuals Unlimited

Meningococcal Meningitis

- Pathogenesis
  - Acquired by inhaling infected respiratory droplets
  - Bacteria adhere to mucous membranes
  - Invade bloodstream by passing through respiratory epithelium
    - Bloodstream carries organisms to CSF
  - Inflammation causes swelling and infarcts to brain tissue
    - Can also cause obstruction of outflow of CSF
      - Causes brain to squeeze against skull
  - Release of endotoxin causes drop in blood pressure leading to shock

Meningococcal Meningitis

- Causative agent - *Neisseria meningiti*
- Epidemiology
  - *N. meningitis* more prone to cause epidemics
  - Can spread rapidly in crowded stressed places
  - Human only source of infection
  - Transmission can occur with disease or asymptomatic carrier
    - Organism recovered from 5% - 15% of healthy individuals

Meningococcal Meningitis

- Prevention and Treatment
  - Vaccine is available
    - Used to control epidemics
    - Not given routinely due to ineffectiveness in children less than 2 years of age
    - Effect is not long lasting
  - Mass prophylaxis with antibiotics helpful at controlling epidemics in small populations
  - Can usually be cured unless brain injury or shock present
    - Mortality is less than 10% in treated populations

TABLE 27.1 Meningococcal Meningitis

① *Neisseria meningitidis* inhaled, infects upper airways.

② Bacteria enter the bloodstream and are circulated throughout the body.

③ The bacteria lodge in the skin and cause petechiae.

④ Bacteria on the meninges causes meningitis.

⑤ Lysing bacteria in the circulation release endotoxin, producing shock.

⑥ Inflammatory response in meninges can damage nerves of hearing causing deafness and obstruct the flow of cerebrospinal fluid causing increased pressure inside the brain.

⑦ Bacteria exit with respiratory secretions.

Symptoms	Mild cold followed by headache, fever, pain, stiff neck and back, vomiting, petechiae
Incubation period	1 to 7 days
Causative agent	*Neisseria meningitidis,* the meningococcus; a Gram-negative diplococcus
Pathogenesis	Meningococci adhere by pili, colonize upper respiratory tract, enter bloodstream; carried to meninges and spinal fluid; inflammatory response obstructs normal outflow of fluid; increased pressure caused by obstructed flow impairs brain function; damage to motor nerves produces paralysis; endotoxin release causes shock.
Epidemiology	Close contact with a case or carrier; inhalation of infectious droplets; crowding and fatigue predispose to the disease.
Prevention and treatment	Conjugate vaccine against serogroups A, C, W135, and Y used to immunize ages 11–55 years; rifampin given to those exposed. Penicillin, ceftriaxone, for treatment.

Viral Meningitis

- Etiology
  - The most common form – caused by echo virus, enterovirus, Coxsackie virus, mumps virus
  - Usually in warm months
- Signs and symptoms
  - Severe headaches, intense photophobia, nuchal rigidity, malaise (usually no LOC)
- Treatment
  - Antiobiotic within 48 hours as a preventative if the etiology is bacterial
  - Vial form is usually self limiting in 7-10 days

Viral Meningitis

- Symptoms
  - Typically abrupt in onset
  - Characterized by
    - Fever
    - Severe headache above or behind eyes
    - Stiff neck with increased pain on forward flexion
    - Sensitivity to light
    - Nausea and vomiting
    - May have sore throat, chest pain, swollen parotid gland and skin rash
      - Depends on causative agent

Viral Meningitis

- Pathogenesis
  - Begins with infection of throat and intestinal epithelium
    - Progresses to lymphoid tissue in the bloodstream
  - Viremia results in meningeal infection
    - May also be responsible for rash and chest pain
- Causative agent
  - Member of the enterovirus subgroup of picornavirus family
  - Responsible for at least half of viral meningitis cases
    - Most common offenders are Coxsackie virus and echovirus

Viral Meningitis

- Epidemiology
  - Relatively stable in environment
    - Can survive in chlorinated water
  - Infected often eliminate virus in feces
    - Often for weeks
  - Transmission via fecal-oral route
  - Mumps virus transmitted via respiratory droplets

Viral Meningitis

- Prevention and Treatment
  - Handwashing and avoidance of crowded swimming pools
    - When aseptic disease present in community
  - No vaccine against Coxsackie virus and echoviruses
    - Mumps virus controlled via immunization

TABLE 27.6 Viral Meningitis

Symptoms	Abrupt onset, fever, severe headache, stiff neck, often vomiting; sometimes sore throat, large parotid glands, rash, or chest pain
Incubation period	Usually 1 to 2 weeks for enteroviruses, 2 to 4 weeks for mumps
Causative agents	Most cases: small non-enveloped RNA enteroviruses of the picornavirus family, usually coxsackie or echoviruses. Mumps virus common in unimmunized populations
Pathogenesis	Viremia from primary infection seeds the meninges. Fewer leukocytes enter cerebrospinal fluid than with bacterial infections, and many are mononuclear, usually no decrease in CSF glucose.
Epidemiology	Enteroviruses transmitted by the fecal-oral route, mumps by respiratory secretions and saliva. Enteroviruses transmission mainly summer and early fall; mumps in fall and winter.
Prevention and treatment	Handwashing, avoiding crowded swimming pools during enterovirus epidemics; mumps vaccine for mumps prevention. No specific treatment.

GI Tract Infections

Bacterial Diarrhea

- Leading cause of death worldwide – 2.5 million fatalities yearly
- Common in infants and small children
- With proper treatment, is rarely fatal
- Spread three ways
  - Contaminated foods
  - Unclean water
  - Person-to-person contact
- Salmonella
  - From contaminated eggs, dairy products, undercooked chicken
    - Profuse watery bloody diarrhea 25-30 times in 24 hours

- Shigella
  - Causes dysentery – a severe infection of the GI tract with profuse, bloody diarrhea and ulcerations of the bloody mucosa
  - Spreads from anal-oral transmission
    - Day care centers, nursing homes, unclean restaurants, toilet seats
  - Also spread in contaminated water
- Vibrio cholerae
  - Was seen in 1800s wagon trains from contaminated water holes
  - Can infect a person and cause death in 24 hours
  - Most recent epidemic in Peru in 1991
- E. coli and Staphlococcus
  - From contaminated water, milk, meat, mayonnaise
  - “traveler’s diarrhea”

Viral Diarrhea

- Most common cause of infectious diarrhea
- Self-limiting with no specific treatment
- Outbreaks common on cruise ships, schools, church socials
- Symptomatic relief from BRAT diet
  - Bananas
  - Rice
  - Applesauce
  - Tea (or Gatorade, flat Sprite, flat Seven-Up

Is the diarrhea bacterial or viral?

- Mild to moderate resolving in 24 hours
  - Usually viral – Treat with BRAT diet & hydration
- Fulminating or near continual diarrhea for more than a few hours or if blood is present
  - Probably bacterial
  - Should obtain stool cultures
  - Treat with ciprofloxin or levofloxacin
  - Usually the cause in 80% of traveler's diarrhea

Traveling in Developing Countries

- Drink only bottled water
- Avoid ice in drinks
- Avoid salads
- Avoid ice cream
- Only eat fruit that you can peel and only peel after you have washed with bottled water
- Be careful with cooked meats and eggs
- Carry Imodium
- Carry antibiotics

Parasitic Intestinal Infections

- Giardiasis – caused by *Giardia lambia*
  - Endemic in daycare centers and campers
  - Abdominal pain, bloating, belching, cramping, diarrhea
  - Because of pain, can mimic appendicitis, ulcerative colitis, Crohn's disease
  - Stool sample is positive in 90% of cases
  - Treatment with Flagyl

Parasitic Intestinal Infections

- Amebiasis – caused by *Entamoaba histolytica*
  - 500 million cases per year with 100,000 deaths
  - Found in tropics, subtropics and crowded unsanitary conditions
  - Watery bloody diarrhea, abdominal pain, fever, tenesmus (powerful rectal cramping), RUQ pain
  - Often mistaken for ulcerative colitis
    - The use of steroids to treat ulcerative colitis can lead to toxic megacolon in amebiasis
      - Colon completely paralyzed and dilated
  - Treatment with Flagyl for 10 days

Hepatitis A

- Over 700,000 Hepatitis cases in USA per year of Hepatitis A, B, C
- Generally prolonged self-limiting lasting 2-3 months
- Outbreaks occur in crowded living conditions
- Transmission is fecal-oral from food or water
- Four week incubation time with no symptoms followed by fatigue, malaise, anorexia, dull RUQ pain, and jaundice
- Diagnosis with high liver enzymes
- Treatment – no known treatment
- Vaccines available for those at high risk
  - Drug users, homosexual men, multiple self partners lifestyle, morticians

Hepatitis B

- Often spread by sexual contact with virus in body fluids
- Infants can get from infected mother
- 280,000 new cases per year in USA and 5% of world population has Hepatitis B
- Long incubation period of 3 months
- Mild to moderate jaundice, nausea, abdominal pain, fever, malaise, appetite loss, dark urine, pale stools
- After initial infection, carriers of Hepatitis B have very few symptoms
- Diagnosis with serologic tests
- Treatment with four separate meds, oral and injections for at least 4 months
- Vaccines are available for high-risk adults

Hepatitis C

- Most common form on USA
  - 150,000 new yearly cases
  - 2-4 million people in USA have chronic Hepatitis C
- Spread is by contaminated blood products
  - Sexual transmission can occur, but is rare
- Incubation is 6-10 weeks
  - 75% are asymptomatic and progress to chronic case
  - 25% of patients develop cirrhosis in 2-3 decades
- Signs and symptoms same as in Hepatitis B
- Treatment of interferon for one year which reduces liver enzyme levels in only 25% of cases
  - 50% of patients awaking liver transplants have chronic hepatitis C

Transmission of Viral Hepatitis

Transmission Route	Hepatitis A	Hepatitis B	Hepatitis C	Hepatitis D	Hepatitis E
Food - Borne	●	■	■	■	●
Fecal - Oral	●	■	■	■	●
Water - Borne	●	■	■	■	●
Raw Shellfish	●	■	■	■	●
Intra-Institutional	●	●	●	●	●
I.V. Drug Use	△	●	●	●	■
Transfusion	△	●	●	●	△
Hemodialysis	■	●	●	●	■
Sexual	△	●	△	●	△
Anal - Oral Contact	●	■	■	■	△
Oral - Oral Contact	●	△	■	■	●
Household	●	△	△	△	●
Mother to Newborn	△	●	△	●	△

● Common △ Infrequent ■ Never ● Suspected

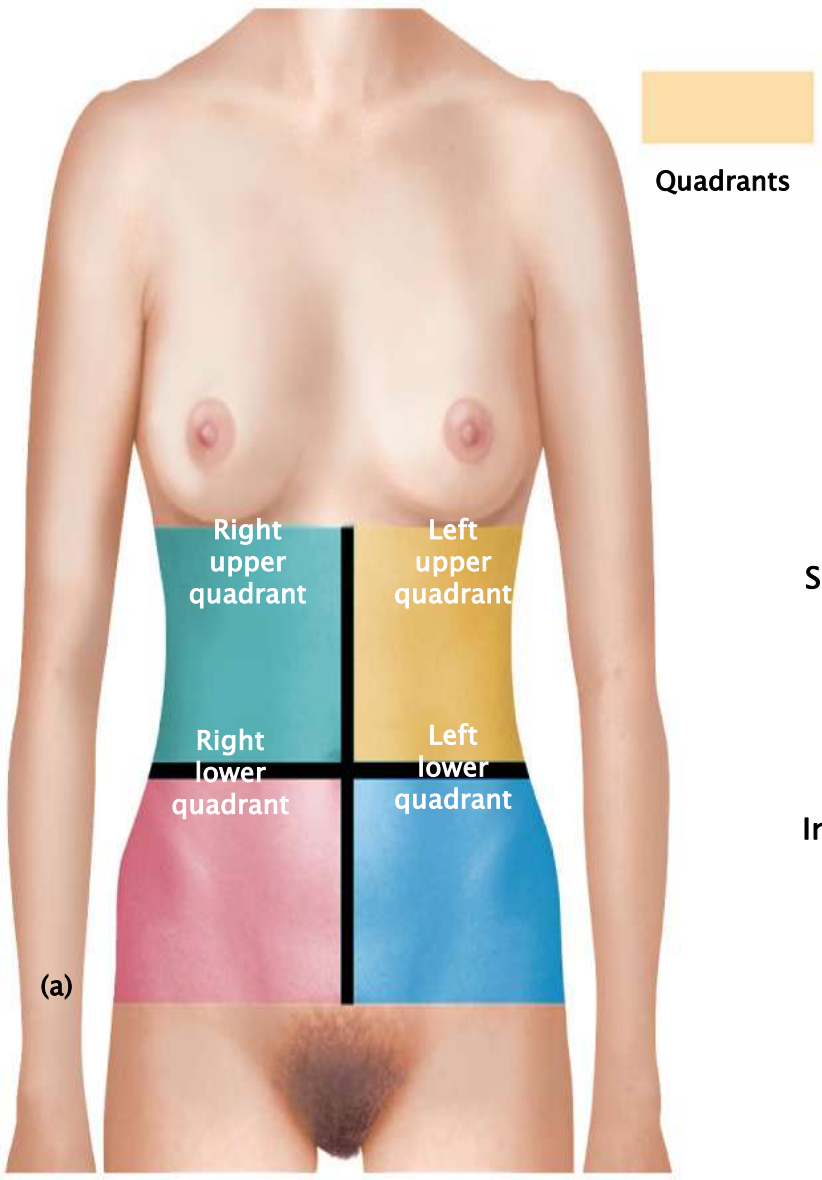
Cholecystitis & Cholangitis

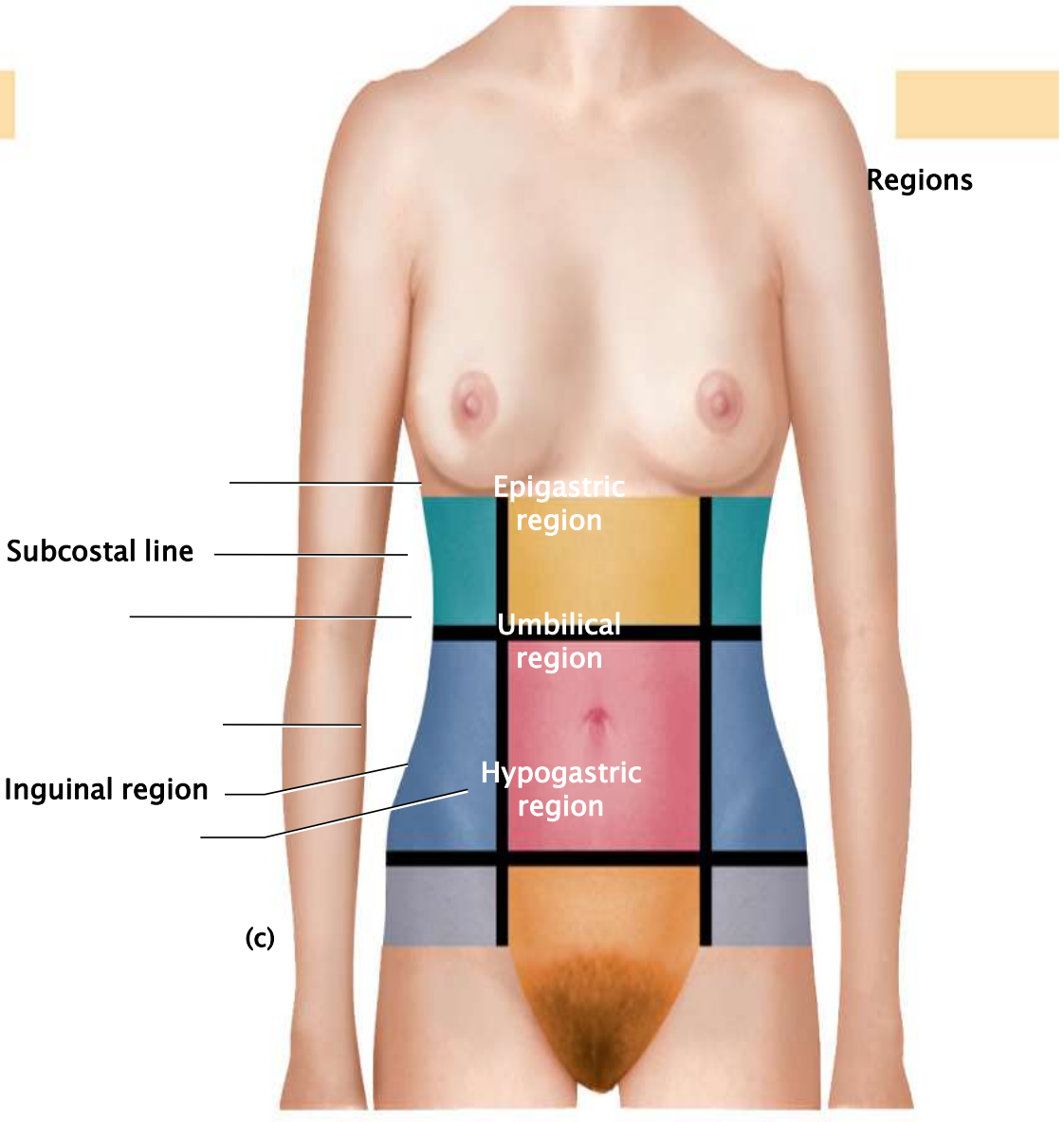
- Infection of gallbladder and bile ducts
- Occur from gallstone obstruction
- Cholelithiasis presents with RUQ pain (especially after ingestion of fatty foods), fever, nausea, vomiting and prostration
- Diagnosis with abdominal ultrasound
- Treatment requires prompt surgery of gall bladder removal and treatment with broad spectrum antibiotics
- YouTube – ultrasound in gallbladder evaluation

Pancreatitis

- Serious and often life-threatening
- Two main causes
  - Impacted gallstone which spreads to the pancreas
  - Heavy alcohol intake
  - Also seen in trauma or with viral (as in mumps)
- Epigastric pain radiating to back, tachycardia, increased sweating and shock
- Diagnosis with pancreatic enzymes, CT, MRI
- Treatment with nasogastric suction to place gut at rest, then IV hydration and Demerol for pain
- May require TPN, total penteral nutrition, for several weeks
- Fatality reduced to 10% with long term treatment and long term recovery

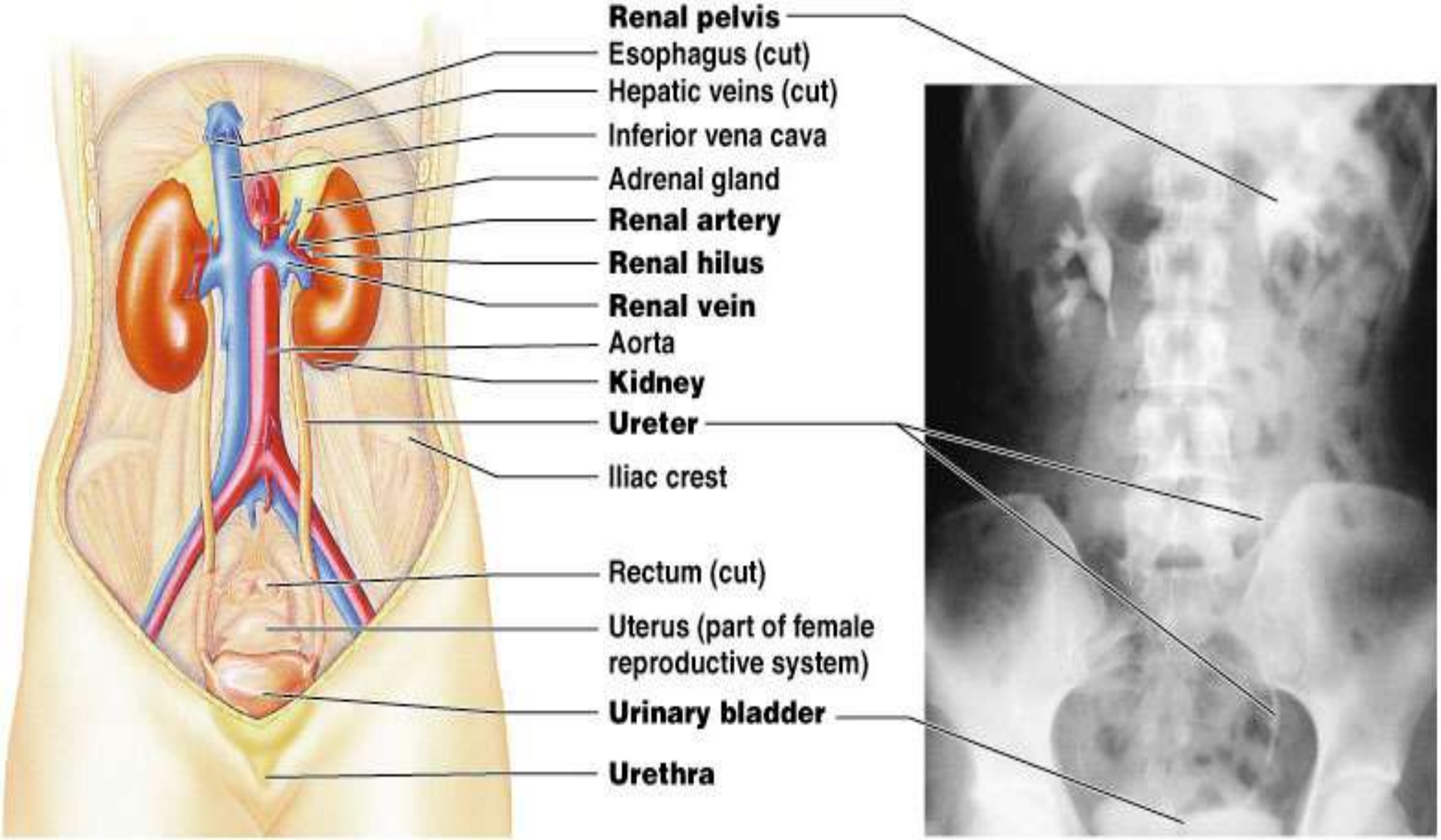
Abdominal Quadrants and Regions





UTI & STD

Urinary System



Urinary Bladder and Urethra

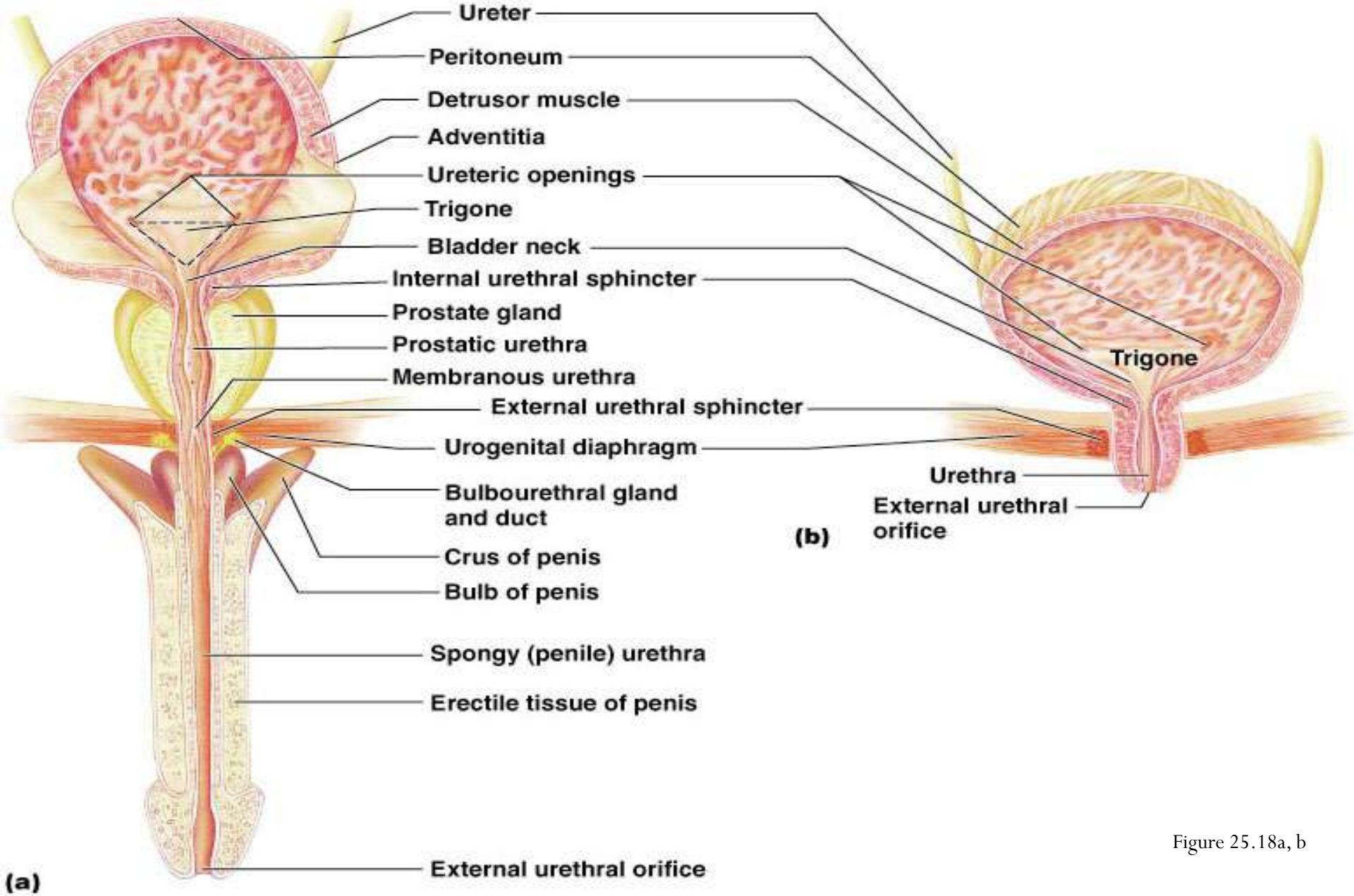


Figure 25.18a, b

UTI

- Can range from common cystitis to life-threatening pyelonephritis with renal failure, septic shock and death
- *E. coli* is most common organism from anorectal cross contamination
- Most common in females, because of anatomy

Symptoms of UTI

- Characterized by urgent desire to empty the bladder
- Frequent and painful urination
- Urine is strong, unpleasant and cloudy
- May have hematuria (blood in the urine)
- While UTI is usually more of an annoyance then a serious health risk, it has the potential to lead to serious kidney infections

Risk Factors of UTI

- Any change in the normal perineal flora
  - Antibiotics, genital infections
  - Feminine hygiene products, tampons, soaps
  - Sexual intercourse, spermicidal use, diaphragms
- Pregnancy
- Obstructions of foreign bodies
- Prostatic hypertrophy
- Neurogenic bladder dysfunction
- Vesicourethral reflux – Facilitates reflux of bacteria
- Genetics

Preventative Measures to Avoid UTI

- Increased fluids
- Cranberry juice inhibits bacteria and acidifies urine
- Avoid spermacides which predispose to UTIs
- Proper personal hygiene
- Overall body cleanliness and hygiene
- Different cultures and different countries have different hygiene standards
- Care with hands and genitals before, during and after sex

Cystitis

- Two kinds – bacterial and interstitial
- Both cause burning urination, urgency and frequency often with back pain and pubic pain
- Bacterial cystitis
  - Pus in urine
  - Treated with Keflex or Ciprofloxin for 7 days
- Interstitial cystitis (painful bladder syndrome)
  - Symptoms as above, may worsen in mentruation, may also have dysparunia (painful intercourse)
  - Diagnosis by history and symptoms
    - May also use UA, cytoscopy to R/O other diseases
  - No effective treatment – adequate hydration

TABLE 26.1 Bacterial Cystitis

Symptoms	Abrupt onset, burning pain on urination, urgency, frequency, foul smell, red-colored urine; with pyelonephritis, fever, chills, back pain, and vomiting
Incubation period	Usually 1 to 3 days
Causative agents	Most due to *Escherichia coli;* other enterobacteria, *Staphylococcus saprophyticus* cause some cases; nosocomial infections with antibiotic-resistant strains of *Pseudomonas, Serratia,* and *Enterococcus* genera
Pathogenesis	Usually, bacteria ascend the urethra, enter the bladder, and attach by pili to receptors on urinary tract epithelium. Sloughing of cells and an inflammatory response ensue. Spread to the kidneys can occur via the ureters, causing pyelonephritis and potential kidney failure.
Epidemiology	Bacterial cystitis is common in women, promoted by a relatively short urethra, use of a diaphragm, and sexual intercourse. Middle-aged men are prone to infection because enlargement of the prostate gland partially obstructs their urethra. Placement of a bladder catheter commonly results in infection.
Prevention and treatment	Taking sufficient fluid to void urine at least four to five times daily, wiping from front to back. Single dose of antimicrobial medication with sexual intercourse may help prevent bacterial cystitis in women. Short-term antimicrobial therapy usually sufficient. Longer treatment for pyelonephritis.

Pyelonephritis

- *E. coli* in 90% of cases – very serious infection
- Pregnant women will have low birth weight births
- Symptoms as in cystitis with the addition of rib angle pain, tenderness, fever, chills, nausea and vomiting
- Diagnosis with history, blood tests, UA, ultrasound
- Treatment must be aggressive to prevent renal failure
  - Patients hospatilized with IV Cipro for two weeks

TABLE 26.3 Bacterial Vaginosis

Symptoms	Gray-white vaginal discharge and unpleasant fishy odor
Incubation period	Unknown
Causative agent	Unknown
Pathogenesis	Uncertain. Marked distortion of the normal microbiota. Increased sloughing of vaginal epithelium in the absence of inflammation. Odor due to metabolic products of anaerobic bacteria. Association with complications of pregnancy, including premature births.
Epidemiology	Associated with many sexual partners or a new partner, but can occur in the absence of sexual intercourse. Probably not a sexually transmitted disease.
Prevention and treatment	No proven preventive measures. Treatment with metronidazole is effective.

TABLE 26.4 Vulvovaginal Candidiasis

Symptoms	Itching, burning, thick white vaginal discharge, redness and swelling
Incubation period	Usually unknown. Generally 3 to 10 days when associated with antibacterial medications
Causative agent	*Candida albicans,* a yeast
Pathogenesis	Inflammatory response to overgrowth of the yeast, which is often present among the normal microbiota. Associated with antibacterial therapy, use of oral contraceptives, pregnancy, and uncontrolled diabetes, but most cases have no identifiable predisposing factor.
Epidemiology	Not contagious. Usually not sexually transmitted.
Prevention and treatment	No proven preventive measures. Intravaginal antifungal medications such as clotrimazole usually effective.

TABLE 26.5 Staphylococcal Toxic Shock Syndrome

Symptoms	Fever, vomiting, diarrhea, muscle aches, low blood pressure, and a rash that peels
Incubation period	3 to 7 days
Causative agent	*Staphylococcus aureus,* certain toxin-producing strains
Pathogenesis	Toxin (TSST-1 and others) produced by certain strains of *S. aureus;* toxins are superantigens, causing cytokine release and drop in blood pressure.
Epidemiology	Associated with certain high-absorbency tampons, leaving tampons in place for long periods of time, and abrasion of the vagina from tampon use. Also as a result of infection by certain toxin-producing *S. aureus* strains in other parts of the body.
Prevention and treatment	Awareness of symptoms. Prompt treatment of *S. aureus* infections; frequent change of tampons by menstruating women. Antimicrobial medication effective against the causative *S. aureus* strain; intravenous fluids.

TABLE 26.7 Common Sexually Transmitted Diseases

Disease	Cause	Comment
Bacterial		
Gonorrhea ("clap")	*Neisseria gonorrhoeae*	Average reported cases per year—340,000. True incidence much higher.
Chlamydial infections	*Chlamydia trachomatis*	Average reported cases per year—800,000. True incidence much higher.
Syphilis	*Treponema pallidum*	Average reported cases (primary and secondary) per year—6,600.
Chancroid	*Haemophilis ducreyi*	Average reported cases per year—50. True incidence much higher.
Viral		
Genital herpes simplex	Herpes simplex virus (HSV)	Not reportable. Estimated 45 million Americans infected; about 85% HSV, type 2.
Papillomavirus infections	Human papillomavirus (HPV)	Not reportable. Estimated 40 million Americans infected.
AIDS	Human immunodeficiency virus (HIV)	Average reported cases per year—40,000.
Protozoal		
Trichomoniasis ("trich")	*Trichomona vaginalis*	Not reportable. Estimated 5 million Americans infected per year.

TABLE 26.6 Symptoms that Suggest STD

1. Abnormal discharge from the vagina or penis
2. Pain or burning sensation with urination
3. Sore or blister, painful or not, on the genitals or nearby; swellings in the groin
4. Abnormal vaginal bleeding or unusually severe menstrual cramps
5. Itching in the vaginal or rectal area
6. Pain in the lower abdomen in women; pain during sexual intercourse
7. Skin rash or mouth lesions

TABLE 26.13 Genital Herpes Simplex

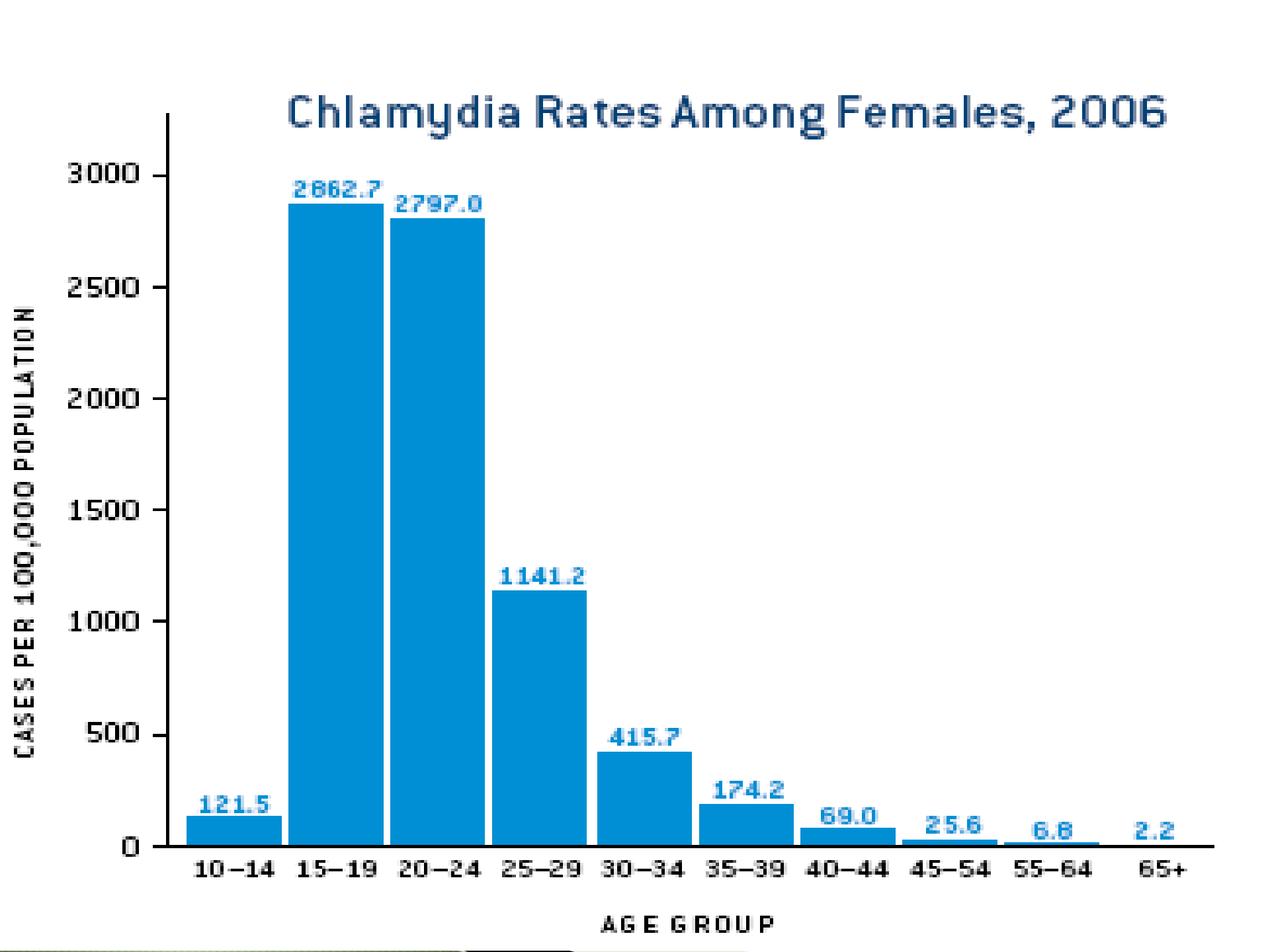
Symptoms	Itching, burning pain at the site of infection, painful urination, tiny blisters with underlying redness. The blisters break, leaving a painful superficial ulcer, which heals without scarring. Recurrences are common.
Incubation period	Usually 1 week (range, 2 to 20 days)
Causative agent	Usually herpes simplex virus, type 2. The cold sore virus, herpes simplex type 1, can also be responsible. Herpesviruses are enveloped and contain double-stranded DNA.
Pathogenesis	Lysis of infected epithelial cells results in fluid-filled blisters containing infectious virions. Rupture of these vesicles causes a painful ulceration. The acute infection is controlled by body defenses; genome persists within nerve cells in a non-infectious form beyond the reach of body defenses. Replication of infectious virions can occur and cause recurrent symptoms in the area supplied by the nerve. Newborn infants can contract fatal generalized herpetic infection if their mother has a primary infection at the time of delivery.
Epidemiology	No animal reservoirs. Transmission by sexual intercourse, oral-genital contact. Transmission risk greatest first few days of active disease. Transmission can occur in the absence of symptoms. Herpes simplex increases the risk of contracting HIV.
Prevention and treatment	Abstinence, monogamy, and condoms help prevent transmission. Medications help prevent recurrences, shorten duration of symptoms. No cure.

TABLE 26.14 Papillomavirus STDs

Symptoms	Many have no symptoms. Warts of the external and internal genitalia the most common symptom.
Incubation period	Usually 3 months (range, 3 weeks to 8 months)
Causative agents	Human papillomaviruses, many types, small, non-enveloped, double-stranded DNA viruses of the papovavirus family. Different types infect different tissues and produce different lesions.
Pathogenesis	Virus enters epithelium through abrasions, infects deep layer of epithelium; establishes latency; cycles of replication occur when host cell begins maturation; cancer-associated viral types can integrate into the host cell chromosome and can cause precancerous lesions.
Epidemiology	Asymptomatic individuals can transmit the disease; 60% transmission with a single sexual contact; multiple sex partners the greatest risk factor; warts can be transmitted to the mouth with oral sex, and to newborn babies.
Prevention and treatment	Latex condoms advised to minimize transmission and avoidance of sexual contact with those having multiple sex partners. Pap tests at least yearly for sexually active women. Wart removal by multiple techniques, does not cure the infection. Imiquimod useful in treating multiple warts about anus and external genitalia.

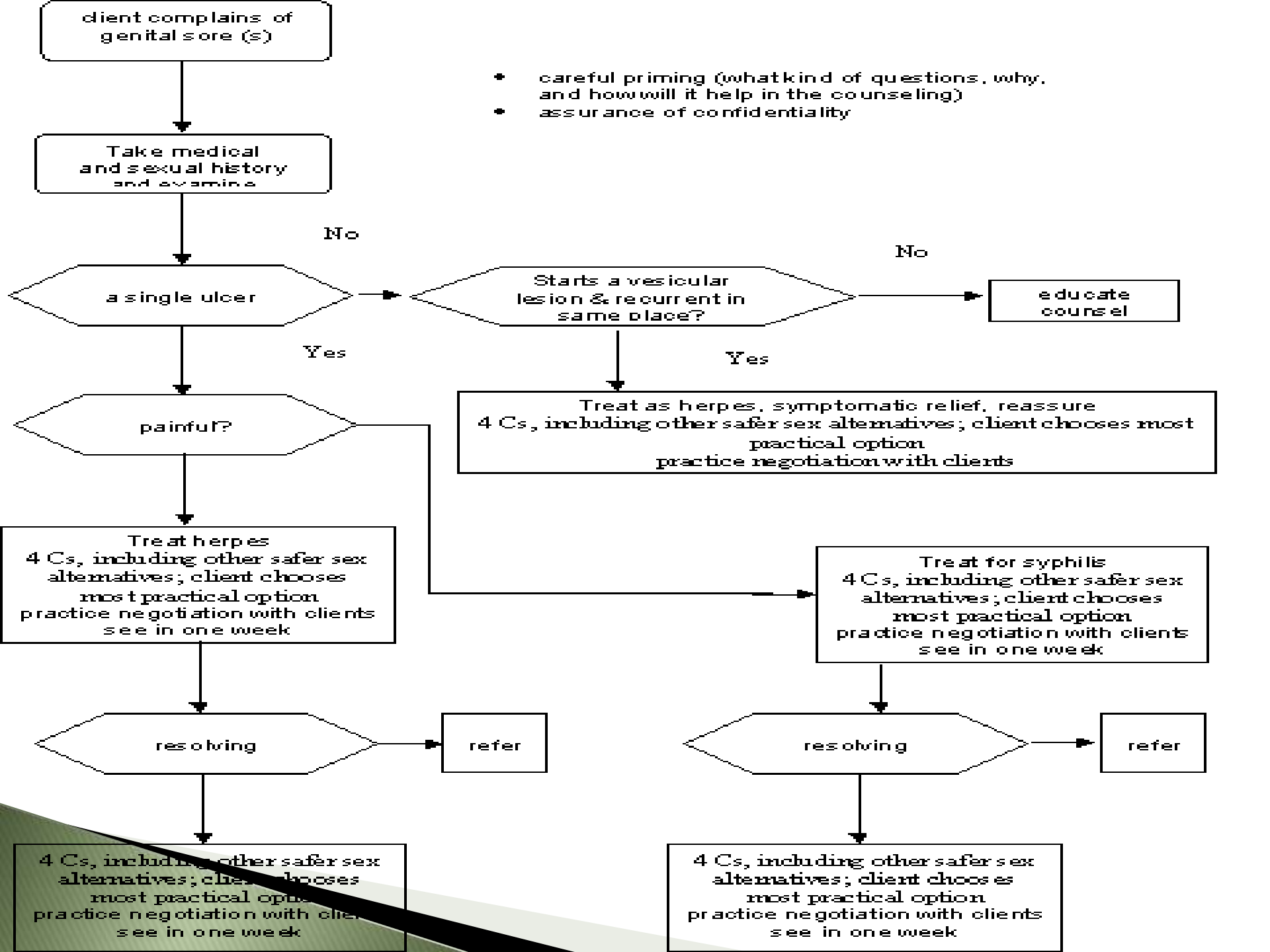
STD – Urethritis

- Results in prurulent discharge with pyuria that can progress into PID
- Has severe pelvic pain and tenderness, with fever
- Diagnosis – gram stain from urethral discharge
  - *Chlamydia trachomatis and Neisseria gonorrheae*
- Treatment with ciprofloxin for gonorrhea and azithromycin for Chlamydia
- Incidence of Chlamydia in USA
  - One in four – most are asymptomatic


Chlamydia Rates Among Females, 2006
CASES PER 100,000 POPULATION
3000
2500
2000
1500
1000
500
0
2862.7
2797.0
1141.2
415.7
174.2
121.5
69.0
25.6
6.8
2.2
10–14
15–19
20–24
25–29
30–34
35–39
40–44
45–54
55–64
65+
AGE GROUP

STD – Genital Ulcers

- Most common cause in *Herpes genitalis* virus
  - Essentially cold sore form of herpes in genitals
- More than 25% of adults in USA carry virus
- Painful ulcers on labia or mons or meatus
- Very tender inguinal nodes
- First attack is usually the worse and subsequent attacks are often brought about by stress
- Diagnosis with blood tests and viral cultures
- Treatment with acylovir, famcylovir or valcylovir for herpes
  - Penicillin is used for syphilis variety


client complains of genital sore (s)
careful priming (what kind of questions, why, and how will it help in the counseling)
assurance of confidentiality
Take medical and sexual history
No
a single ulcer
Starts a vesicular lesion & recurrent in same place?
No
educate counsel
Yes
Yes
painful?
Treat as herpes, symptomatic relief, reassure 4 Cs, including other safer sex alternatives; client chooses most practical option practice negotiation with clients
Treat herpes 4 Cs, including other safer sex alternatives; client chooses most practical option practice negotiation with clients see in one week
Treat for syphilis 4 Cs, including other safer sex alternatives; client chooses most practical option practice negotiation with clients see in one week
resolving
refer
resolving
refer
4 Cs, including other safer sex alternatives; client chooses most practical option practice negotiation with clients see in one week
4 Cs, including other safer sex alternatives; client chooses most practical option practice negotiation with clients see in one week

STD – Genital Papules (Warts)

- Usually caused by HPV – human papilloma virus
- Incidence is 5 million new cases each year with 20 million harbor the virus
- Lesions seen in genital and anal areas from a few lesions to hundreds – can also be asymptomatic
- Diagnosis with a complete workup with colposcopy with lesions biopsied
- Treatment includes removing lesions with laser, electrocautery or topical podophyllin (OTC)

TABLE 26.11 Syphilis

① *Treponema pallidum* enters the body through a microscopic abrasion or mucous membrane, usually genitalia, mouth, or rectum.

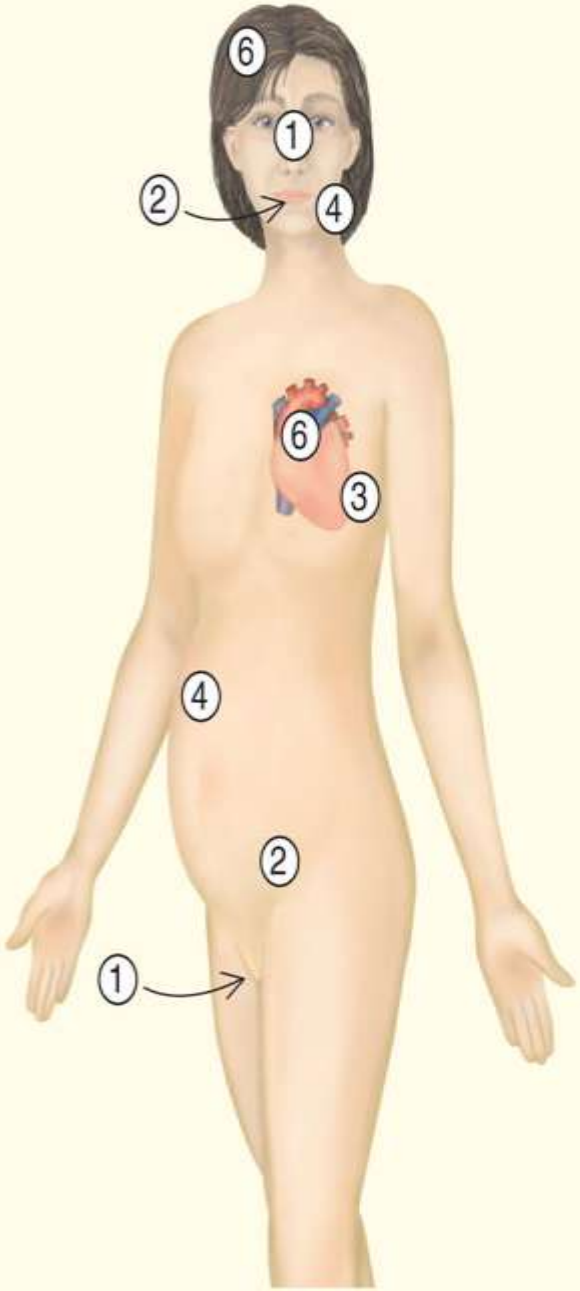
② A chancre develops at site of entry.

③ Organisms multiply locally and spread throughout the body by the bloodstream.

④ Infectious mucous patches and skin rashes of secondary syphilis appear. A fetus will become infected, resulting in miscarriage or a live-born infant with congenital syphilis.

⑤ An asymptomatic latent period occurs. *T. pallidum* disappears from blood, skin, and mucous membranes.

⑥ After months or years, symptoms of tertiary syphilis appear:
- heart and great vessel defects
- gummas
- strokes
- eye abnormalities
- general paresis
- insanity.



Symptoms	Chancre, fever, rash, stroke, nervous system deterioration; can imitate many other diseases
Incubation period	10 to 90 days
Causative agent	*Treponema pallidum,* a non-culturable spirochete
Pathogenesis	Primary lesion, or chancre, appears at site of inoculation, heals after 2 to 6 weeks; *T. pallidum* invades the blood vessel system and is carried throughout the body, causing fever, rash, mucous membrane lesions; damage to brain, arteries, and peripheral nerves appears years later.
Epidemiology	Sexual contact with infected partner; kissing; transplacental passage.
Prevention and treatment	Monogamous relationships, use of condoms, treatment of sexual contacts, reporting cases. Treatment: penicillin.

TABLE 26.8 Gonorrhea

① Eyes of adults and children are susceptible to the gonococcus; serious infections leading to loss of vision are likely in newborns.

② Organisms carried by the bloodstream infect the heart valves and joints.

③ The outer covering of the liver is infected when gonococci enter the abdominal cavity from infected fallopian tubes.

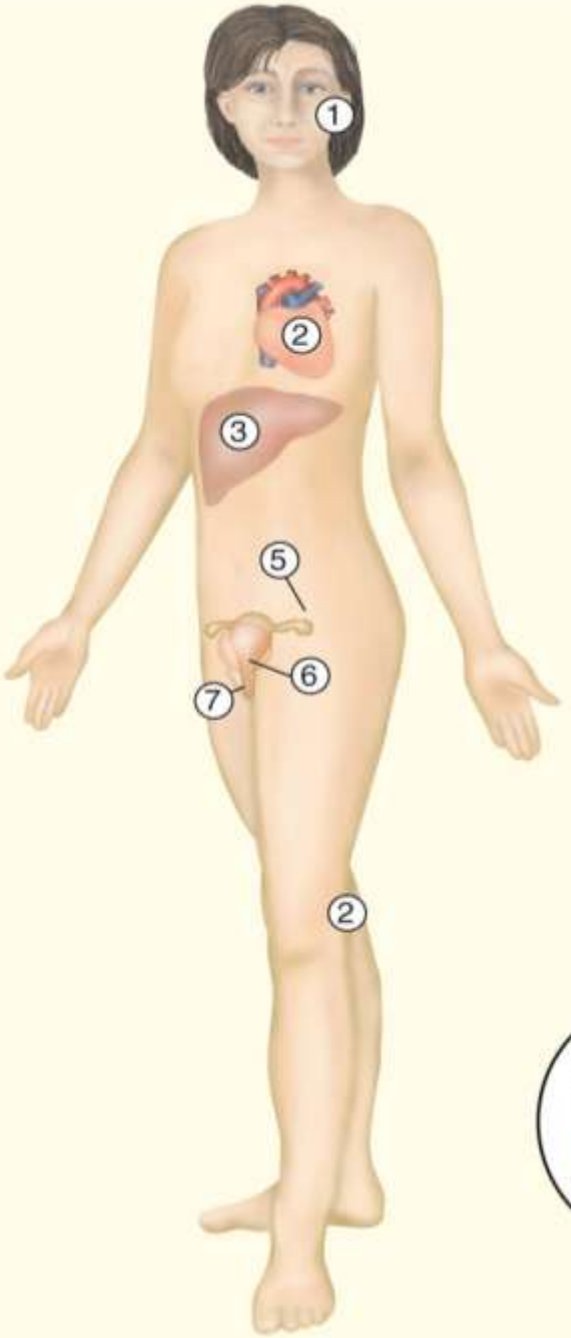
④ Prostatic gonococcal abscesses may be difficult to eliminate.

⑤ Infection of the fallopian tubes results in scarring, which can lead to sterility or ectopic pregnancy.

⑥ The cervix is the usual site of primary infection in women.

⑦ Urethral scarring from gonococcal infection can predispose to urinary infections by other organisms.

⑧ Scarring of testicular tubules can cause sterility.



male

Symptoms	Men: no symptoms, pain on urination, discharge; with complication impaired urinary flow, sterility, or arthritis. Women: no symptoms or pain on urination, discharge, fever, pelvic pain, sterility, ectopic pregnancy, arthritis can occur
Incubation period	2 to 5 days
Causative agent	*Neisseria gonorrhoeae,* a Gram-negative diplococcus
Pathogenesis	Organisms attach to certain non-ciliated epithelial cells by pili; phase and antigenic variation in surface proteins allows attachment to different host cells and escape from immune mechanisms. Inflammation, scarring; can spread by bloodstream.
Epidemiology	Transmitted by sexual contact. Asymptomatic carriers. No immunity.
Prevention and treatment	Abstinence, monogamous relationships, condoms, early treatment of sexual contacts. Treatment: intramuscular ceftriaxone.

Bone and Joint Infections

Osteomyelitis

- Bone infection from hematogenous spread
  - *Staphlococcus or Streptococcus*
- Usually seen in young children (affecting long bones) and elderly (affecting vertebral bodies)
- Can be seen in diabetic or ischemic ulcers
  - These deep sores occur in feet or legs or pelvis
- Can be seen in post-operative orthopedic surgery
- Can be acute over several days or chronic over weeks to months
- Symptoms – dull pain, fever, chills
- Diagnosis with CT, MRI, x-rays
- Treatment with specific IV antibiotics after cultures received, surgical debridement, revascularization

Septic Arthritis

- Life-threatening infection caused by hematogenous spread - *Staphlococcus*
- Common source is IV catheters, severe UTIs
- Most likely to occur in patients with joint pathology from RA or degenerative arthritis
- Acute joint pain, immobility, tenderness, swelling
- Diagnosis with synovial fluid culture
  - If aspiration yields pus, dx is septic arthritis
  - If aspiration yields uric acid crystals, dx is gout
- Treatment with nafcillin for one month

Infection in Prosthetic Joints

- Prosthetic joint infection can be rapid or slow and can take up to six months after surgery
- Symptoms – pain, redness, swelling, fever, joint pain
- Diagnosis is difficult as patients mimic common complications following joint surgery
  - Biopsy of joint tissue and synovial fluid analysis
- Treatment requires removing of prosthesis so the joint is not used followed by antibiotics for 1-3 months followed by new prosthesis

HIV & AIDS

- C

Is HIV and AIDS the same thing?

World AIDS Campaign

HIV

- “Human Immunodeficiency Syndrome”
- A specific type of virus (a retrovirus)
- HIV invades the helper T cells to replicate itself.
- No Cure

AIDS

- Acquired Immunodeficiency Syndrome
- HIV is the virus that causes AIDS
- Disease limits the body's ability to fight infection
- A person with AIDS has a very weak immune system
- No Cure

Four Stages of HIV

Stage 1 - Primary

- Short, flu-like illness – occurs one to six weeks after infection
- no symptoms at all
- Infected person can infect other people

Stage 2 - Asymptomatic

- Lasts for an average of ten years
- This stage is free from symptoms
- There may be swollen glands
- The level of HIV in the blood drops to very low levels
- HIV antibodies are detectable in the blood

Stage 3 - Symptomatic

- The symptoms are mild
- The immune system deteriorates
- Emergence of opportunistic infections and cancers

Stage 4 - HIV ⇨ AIDS

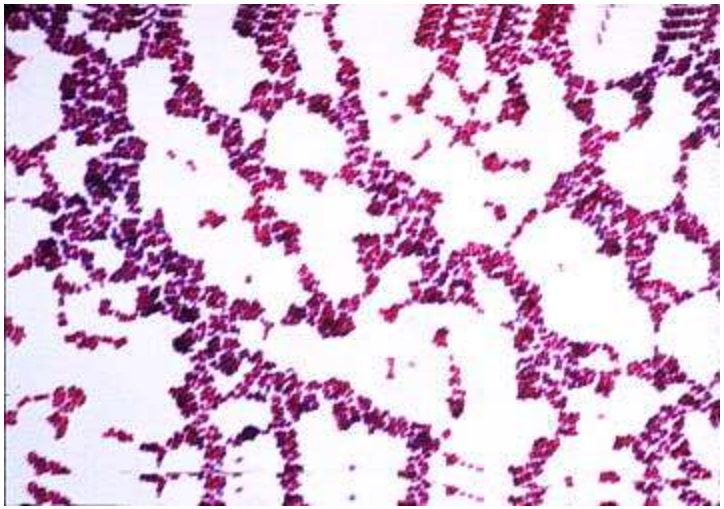
- The immune system weakens
- The illnesses become more severe leading to an AIDS diagnosis

Opportunistic Infections associated with AIDS

- Bacterial
  - Tuberculosis (TB)
  - Strep pneumonia
- Viral
  - Kaposi Sarcoma
  - Herpes
  - Influenza (flu)

Opportunistic Infections associated with AIDS

- Parasitic
  - Pneumocystis carinii
- Fungal
  - Candida
  - Cryptococcus



AIDS

- Epidemiology
  - HIV is spread mainly through sexual contact, needles or from mother to newborn
  - Virus not highly contagious outside of risk factors
  - Transmission can be halted by changes in human behavior

- Prevention and Treatment
  - Interruption of mother to child transmission via chemotherapy
  - Needle exchange programs
  - Educational programs targeting at risk populations
  - Treatment of other STD to lessen risk on contracting HIV
  - Treatment is designed to block replication of HIV
    - Generally with cocktail of medication

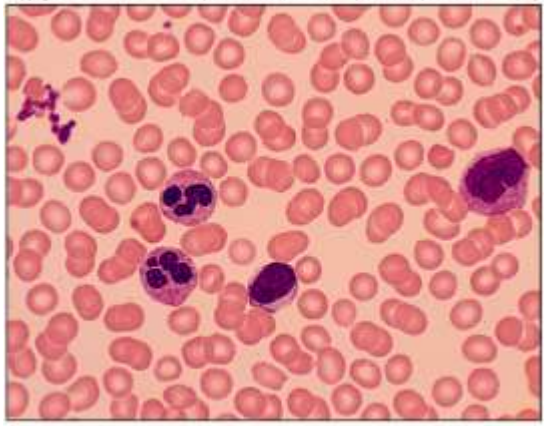
TABLE 26.15 HIV Disease and AIDS

Symptoms	No symptoms, or "flu"-like symptoms early in the illness; an asymptomatic period typically lasting years; symptoms of lung, intestine, skin, eyes, brain, and other infections, and certain cancers
Incubation period	About 6 days to 6 weeks for "flu"-like symptoms; many months or years for cancers and unusual infections
Causative agents	Generally human immunodeficiency virus, type 1 (HIV-1)
Pathogenesis	The virus infects $CD4^+$ lymphocytes and macrophages, thereby slowly destroying the ability of the immune system to fight infections and cancers.
Epidemiology	HIV present in blood, semen, and vaginal secretions in symptomatic and asymptomatic infections; spread usually by sexual intercourse, sharing of needles by injected-drug abusers, and from mother to infant at childbirth. Other STDs foster transmission.
Prevention and treatment	Abstinence from sexual intercourse and drug abuse; monogamy; consistent use of latex condoms; avoidance of sexual contact with injected-drug abusers, those with multiple partners or history of STDs. Anti-HIV medication for expectant mothers and their newborn infants. Treatment: reverse transcriptase and protease inhibitors in combination.

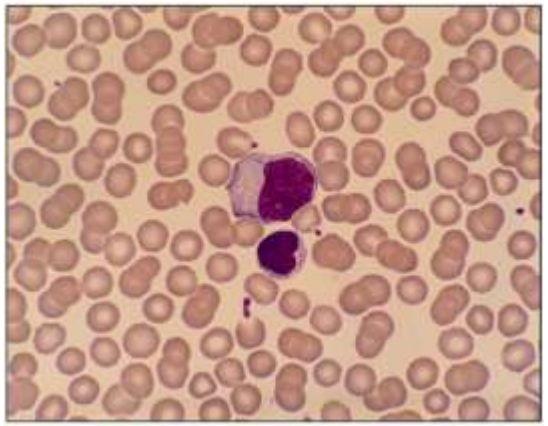
Blood Diseases

Infectious Mononucleosis

- Symptoms
  - Appear after long incubation
    - Usually 30 to 60 days post infection
  - Symptoms include fever, sore throat covered with pus, fatigue, enlarged lymph nodes and spleen
  - Most cases fever and sore throat disappear within 2 weeks, lymph node enlargement within 3



(a)



(b)

Infectious Mononucleosis

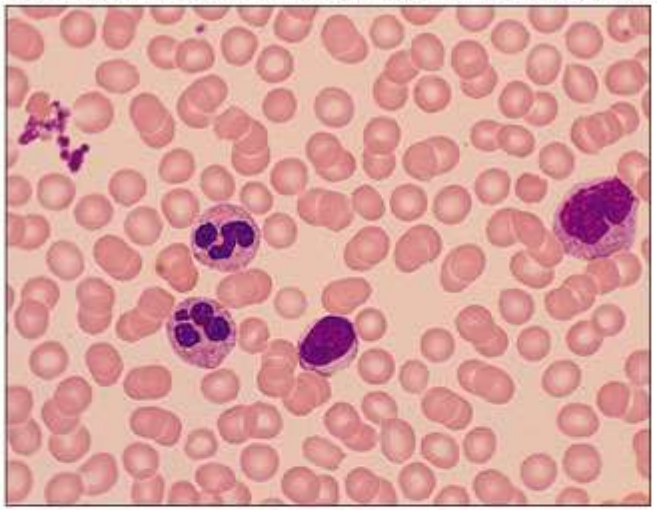
- Causative agent
  - Caused by Epstein-Barr virus
    - Belongs to herpesvirus family
- Pathogenesis
  - Infection begins in cells of throat and mouth and become latent in another cell type
  - Virus carried to lymph nodes after replication in epithelial cells of mouth, saliva producing glands and throat
  - Infects B lymphocytes
  - Virus activates B cells to produce multiple clones

Infectious Mononucleosis

- Epidemiology
  - Infects individuals in crowded areas
    - Infects at early age without producing symptoms producing immunity
    - More affluent populations missed exposure and lack immunity
  - Occurs almost exclusively in adolescents and adults who lack antibody
  - Virus present in saliva for up to 18 months
    - Mouth-to-mouth kissing important mode of transmission
  - No animal reservoir

Infectious Mononucleosis

- Prevention and Treatment
  - Avoiding saliva of another person
  - No vaccine
  - Acyclovir inhibits productive infection
    - Has no activity on latent viruses



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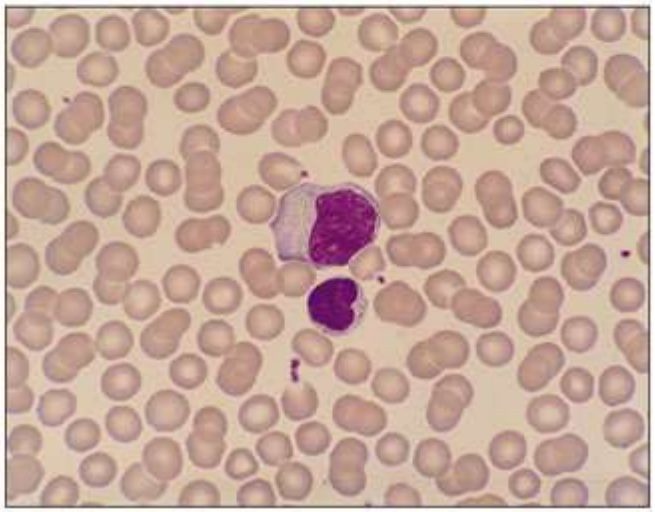


(b)

TABLE 28.6 "Kissing Disease" (Infectious Mononucleosis, "Mono")

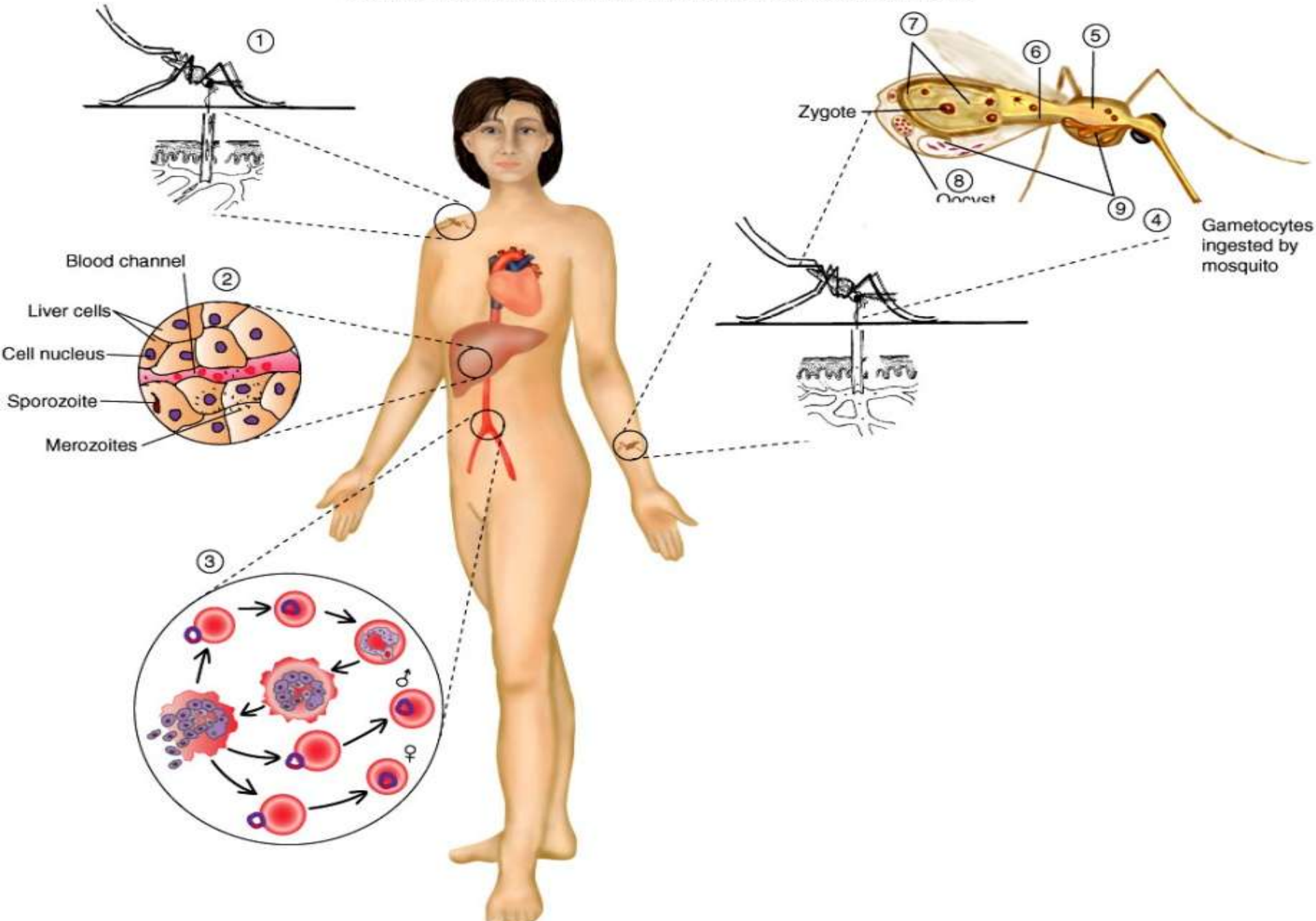
Symptoms	Fatigue, fever, sore throat, and enlargement of lymph nodes
Incubation period	Usually 1 to 2 months
Causative agent	Epstein-Barr (EB) virus, a DNA virus of the herpesvirus family
Pathogenesis	Productive infection of epithelial cells of throat and salivary ducts; latent infection of B lymphocytes; activation of B and T lymphocytes; hemorrhage from enlarged spleen is a rare but serious complication.
Epidemiology	Spread by saliva; lifelong recurrent shedding of virus into saliva of asymptomatic, latently infected individuals.

Malaria

- Symptoms
  - “flu-like”
  - Includes fever, headache and pain in the joints and muscles
  - Generally begin 2 weeks post infection
    - Transmission via bite of infected mosquito
  - Symptom pattern changes after 2 to 3 weeks
    - Falls into three categories
      - Cold phase – abruptly feels cold and develops shaking
      - Hot phase – follows cold phase
        - Temperature rises steeply reaching 104°F
      - Wet phase – follows hot phase
        - Temperature falls and drenching sweat occurs

Malaria

- Causative agent
  - Human malaria caused by four species of genus *Plasmodium*
    - *P. vivax, P. falciparum,*
      P. malatiae, P. ovale
  - Infectious form of parasite injected via mosquito
  - Carried by bloodstream to liver
    - Infects cells of liver
      - Thousands of offspring released to produce infection in erythrocytes

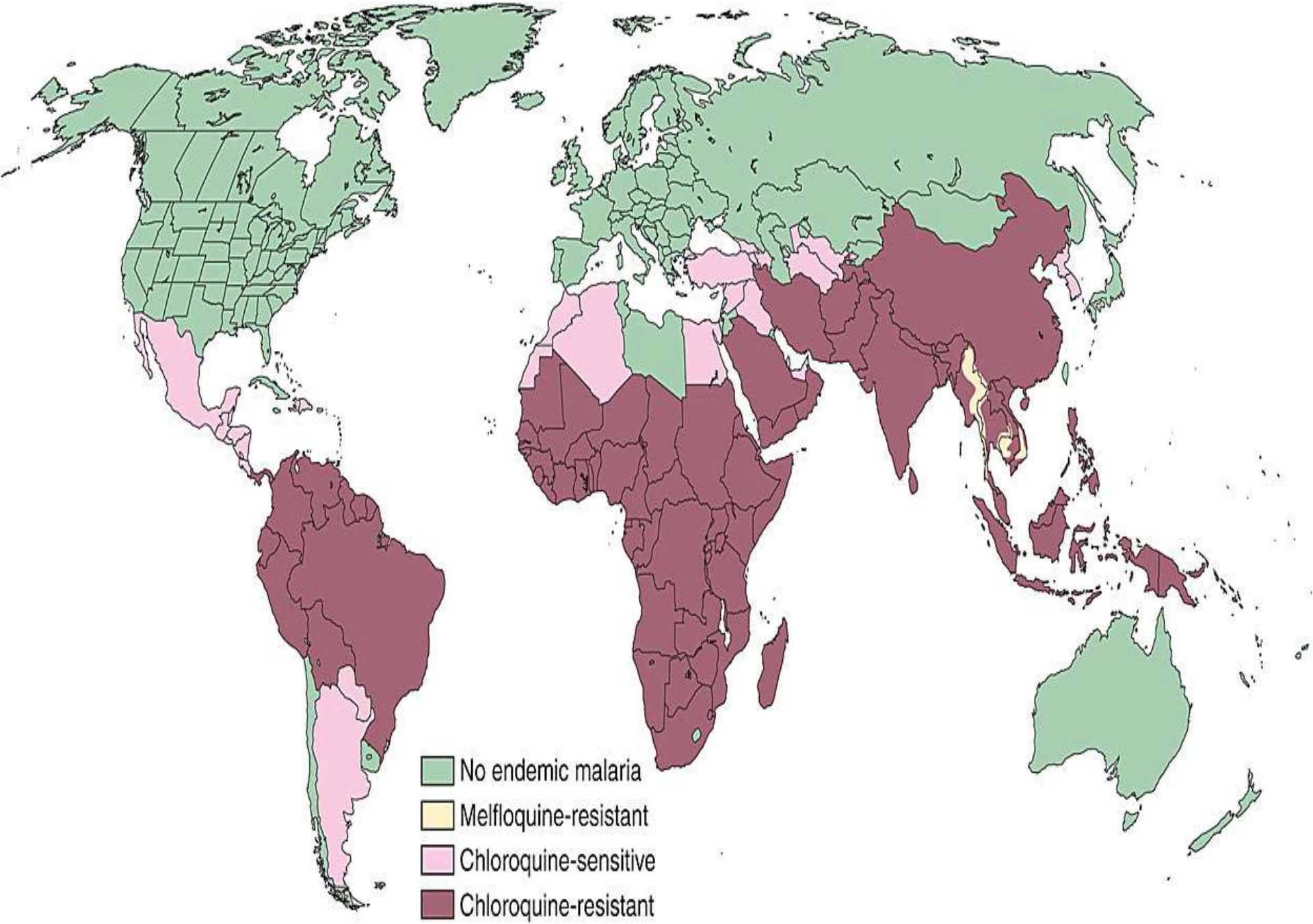


Malaria

- Pathogenesis
  - Characteristic feature
    - Recurrent bouts of fever followed by times of wellness
  - Each species has different incubation periods, degrees of severity and preferred host age and range
  - Spleen enlarges to cope with large amount of foreign material and abnormal RBC
    - Common cause of splenic rupture
  - Parasites cause anemia by destroying red RBC and converting iron from hemoglobin to non-usable form
  - Stimulates immune system
    - Overworked immune system fails and immunodeficiency develops

Malaria

- Epidemiology
  - Once common in both temperate and tropical areas
    - Now dominantly disease of warm climate
  - Eliminated from continental U.S. in late 1940's
  - Mosquitoes of genus *Anopheles* are biological vectors
  - Infected mosquitoes and humans constitute reservoir
  - Transmission via mosquitoes, blood transfusion and sharing of syringes



Malaria

- Prevention and Treatment
  - Treatment is complicated
  - Chloroquine
    - Effective against erythrocyte stage. Will not cure liver infection
  - Primaquine and tafenoquine
    - Generally effective against exoerythrocyte stage and certain species gametocytes

- Malaria: No Ordinary Mosquito Bite

TABLE 28.8 Malaria

Symptoms	Recurrent bouts of violent chills and fever alternating with feeling healthy
Incubation period	Varies with species; 6 to 37 days
Causative agent	Four species of protozoa of the genus *Plasmodium*
Pathogenesis	Cell rupture, release of protozoa causes fever; infected red blood cells adhere to each other and to walls of capillaries; in the case of *falciparum* malaria; vessels plug up, depriving tissue of oxygen; spleen enlarges in response to removing large amount of foreign material and many abnormal blood cells from the circulation.
Epidemiology	Transmitted from person to person by bite of infected anopheline mosquito. Some individuals genetically resistant to infection.
Prevention and treatment	For prevention, weekly doses of chloroquine if in chloroquine-sensitive malarial areas; doxycycline, mefloquine, or other alternative if in chloroquine-resistant areas; after leaving, primaquine is given for liver stage; ACTs or other medicines for resistant strains; eradication of mosquito vectors; mosquito netting impregnated with insecticide; vaccines under development. Treatment: usually ACTs; other medicines if sensitivity known.

Blood Diseases: Anemia

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Components of Whole Blood

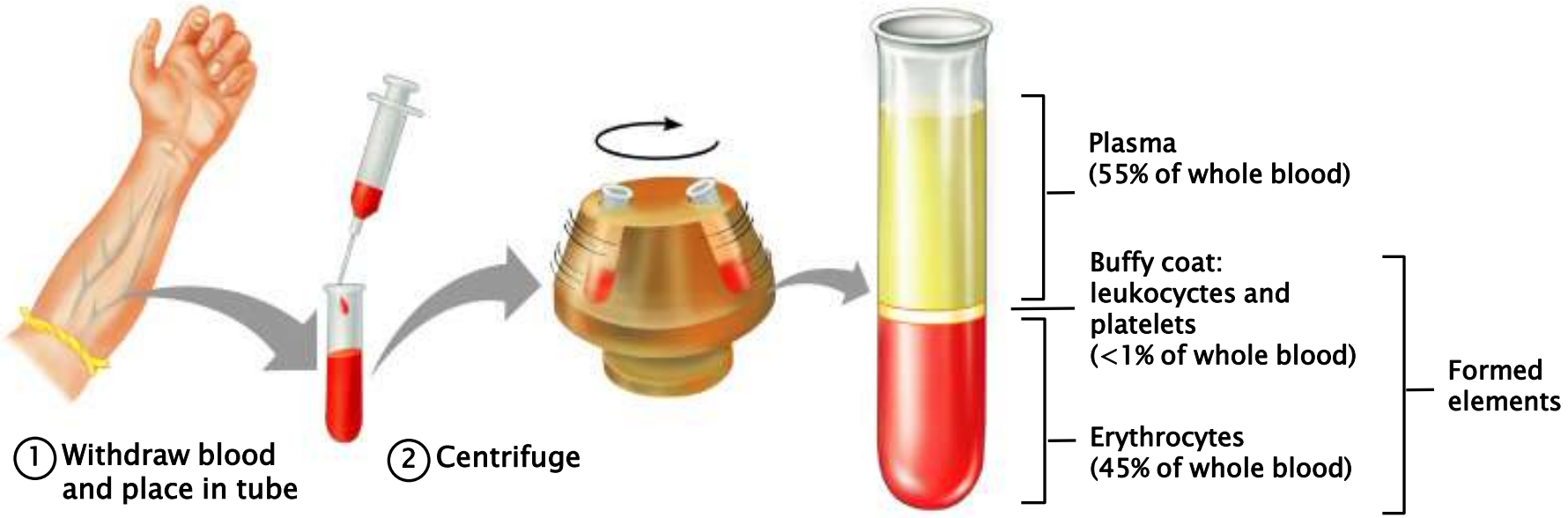

TABLE 17.2 Summary of Formed Elements of the Blood

Cell Type	Illustration	Description*	Cells/mm^3 (μl) of Blood	Duration of Development (D) and Life Span (LS)	Function
Erythrocytes (red blood cells, RBCs)		Biconcave, anucleate disc; salmon-colored; diameter 7–8 μm	4–6 million	D: 5–7 days LS: 100–120 days	Transport oxygen and carbon dioxide
Leukocytes (white blood cells, WBCs)		Spherical, nucleated cells	4800–10,800		
Granulocytes					
▪ Neutrophil		Nucleus multilobed; inconspicuous cytoplasmic granules; diameter 10–12 μm	3000–7000	D: 6–9 days LS: 6 hours to a few days	Phagocytize bacteria
▪ Eosinophil		Nucleus bilobed; red cytoplasmic granules; diameter 10–14 μm	100–400	D: 6–9 days LS: 8–12 days	Kill parasitic worms; destroy antigen-antibody complexes; inactivate some inflammatory chemicals of allergy

*Appearance when stained with Wright's stain.

TABLE 17.2 Summary of Formed Elements of the Blood (continued)

Cell Type	Illustration	Description*	Cells/mm^3 (μl) of Blood	Duration of Development (D) and Life Span (LS)	Function
▪ Basophil		Nucleus lobed; large blue-purple cytoplasmic granules; diameter 8–10 μm	20–50	D: 3–7 days LS: ? (a few hours to a few days)	Release histamine and other mediators of inflammation; contain heparin, an anticoagulant
Agranulocytes					
▪ Lymphocyte		Nucleus spherical or indented; pale blue cytoplasm; diameter 5–17 μm	1500–3000	D: days to weeks LS: hours to years	Mount immune response by direct cell attack or via antibodies
▪ Monocyte		Nucleus U or kidney shaped; gray-blue cytoplasm; diameter 14–24 μm	100–700	D: 2–3 days LS: months	Phagocytosis; develop into macrophages in tissues
Platelets		Discoid cytoplasmic fragments containing granules; stain deep purple; diameter 2–4 μm	150,000–400,000	D: 4–5 days LS: 5–10 days	Seal small tears in blood vessels; instrumental in blood clotting

*Appearance when stained with Wright's stain.

Leukocytes (WBCs)

- Leukocytes, the only blood components that are complete cells:
  - Are less numerous than RBCs
  - Make up 1% of the total blood volume
  - Can leave capillaries via diapedesis
  - Move through tissue spaces
- Leukocytosis – WBC count over 11,000 per cubic millimeter
  - Normal response to bacterial or viral invasion

Number of Leuckocytes
“Never Let Monkeys Eat Bananas”

From the most to the least prevalent

Neutrophils, Lymphocytes, Monocytes, Eosinophils, Basophils

- Neutrophils
  - Attracted to sites of inflammation
  - Neutrophils are our body's bacteria slayers
  - Are phagocytic
- Lymphycytes
  - Critical role in immunity with NK cells and T cells
- Monocytes
  - Have massive appetites
  - Defends against chronic infections, viruses and parasites
- Eosinophils
  - Kills parasites, cancer cells and in allergic responses
- Basophils
  - Allergic responses

Hematology terms

- Anemia – low red count
  - Normal is 5 million/cubic mm
- Polycythemia – high red count
- Luekopenia – low white count
  - Normal is 4,000 to 10,000/ cubic mm
- Luekocytosis – high white count
- Thrombocytopenia – low platelet count
- Thrombocytosis – high platelet count
- Hematocrit – % of RBC of total blood volume
  - Male 47% – Female 42%
- Hemoblogin
  - 14-18 is normal per ml

Anemia

- Hematocrit less than 41 in males and 37 in females
- Anemia is usually asymptomatic until HcT below 30
- Develops constant fatigue, tachycardia, palpitations, skin and mucosal dryness, smooth white tongue
- Two main causes
  - Diminished production of RBCs
  - Acceleration of RBC destruction

Blood Diseases: WBC

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White cell disorders

- Neutropenia – too few WBC
  - Side effects of drugs, chemo, radiation therapy
  - Also caused by B12 or folic acid deficiency
- Lymphocytopenia – too few lymphocytes
  - Result of drug toxicities and AIDS
- Leukocytosis – high white cell counts
  - Seen in bacterial and viral infections and TB

Two major acute leukemias

- Acute myelocytic leukemia
  - Massive numbers of immature WBC in blood
  - Most common type of leukemia, especially in seniors
  - Weakness, fatigue, malaise, sweating, infections
  - Can be fatal within weeks
    - With chemo, 5 year survival rate is 40%
- Acute lymphocytic leukemia
  - Most common cancer in children
  - Can often get meningitis, can also develop renal or liver failure
  - 80% survival in children, 40% survival in adults

Two major chronic leukemias

- Chronic myelocytic leukemia
  - More rare, seen in 40-60 year olds
  - Can be mild or have no symptoms
- Chronic lymphocytic leukemia
  - Most common chronic leukemia
  - Average age of 55
  - Unknown etiology

Polycythemia vera

- Opposite of anemia – increased RBC count
  - HcT levels over 55
- Symptoms – symptomatic at first, followed by headaches, dizziness, itchiness, LUQ fullness, dynspnea
- May have massive splenomegaly
- Diagnosis – blood count and testing, liver enlargement
- Treatment with phlebotomy weekly

Acute Red Flags in Infectious Diseases

- Severe flu
- Bacterial infections not being treated
- Keratitis
- Any pneumonia
- Myocarditis, endocarditis, pericarditis
- Catheter infections
- Any CNS signs and symptoms
- Hepatitis, pancreatitis, cholecytitis, cholangitis
- Untreated UTI and STD
- Bone and joint infections
- Suspected exposure to HIV
- Tropical diseases

Subacute Red Flags

- Suspected tuberculosis
- Parasitic infections
- Lyme disease
- Leukemias
- Anemias
- Hemophilias
- White cell disorders