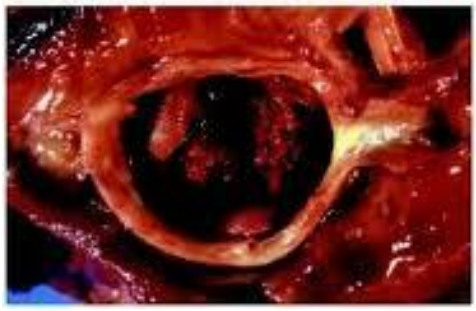
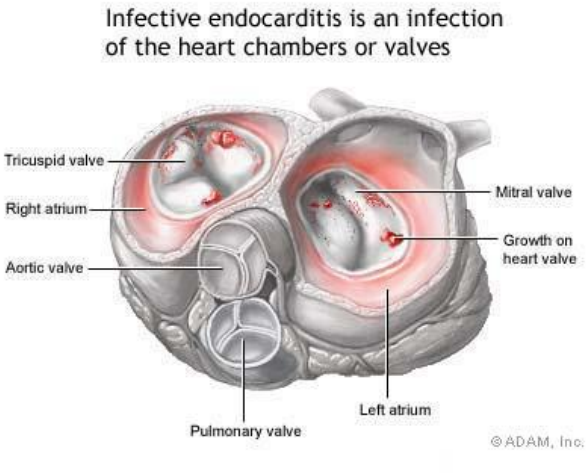
Blood and Lymphatic Infections

Lecture 24 – Dr. Gary Mumaugh

Subacute Bacterial Endocarditis

- Symptoms
  - Marked fatigue and slight fever
  - Typically become ill gradually
    - Slowly lose energy over a period of weeks or months
  - Abrupt development of stroke may occur
- Causative Agent
  - Usually member of normal bacterial flora of mouth and skin
    - α-hemolytic viridians streptococci and *Staphylococcus epidermis*
- Pathogenesis
  - Bacteria gain entry to bloodstream during dental procedures, toothbrushing or other trauma to mouth or skin
  - Organisms may become trapped in clots formed near deformed heart valves
    - Organism may multiply and produce biofilms
      - Organisms inaccessible to phagocytic killing
  - As organisms multiply more clot is formed
    - Clot builds to fragile mass
      - Bacteria break away from clot and are washed away
      - Clots may block significant vessels
  - Masses of organism growing in heart can burrow into tissue and cause abscesses





- Epidemiology
  - Viridians streptococci account for smaller portion of cases
    - Due to dentist prescribing antibiotics to patients with distinct heart murmurs before treatment
  - More cases of disease produced by *Staphylococcus epidermidis*
    - Occur most often in
      - Injected-drug users
      - Patients with intravenous catheter
        - Particularly if used for extended periods
      - Individuals with artificial heart valves

Subacute Bacterial Endocarditis

- Prevention and Treatment
    - No proven prevention
        - Antimicrobial treatment to susceptible population previous to dental procedures most notable attempt to prevent
        - Rigid attention to sterile technique helps prevent occurrence in hospital setting
    - Only bacteriocidal medications are effective in treatment
        - Usually two or more given together for prolonged period
            - Penicillin and gentamicin given over one or more months

Symptoms	Fever, loss of energy over a period of weeks or months; sometimes, a stroke
Incubation period	Poorly defined, usually weeks
Causative agents	Usually oral α-hemolytic viridans streptococci or *Staphylococcus epidermidis*
Pathogenesis	Normal microbiota gain entrance to bloodstream through dental procedures, other trauma; in an abnormal heart, turbulent blood flow causes formation of a thin clot that traps circulating organisms; a biofilm forms, makes them inaccessible to phagocytic killing; pieces of clot break off, block important blood vessels, leading to tissue death.
Epidemiology	Persons at risk are mainly those with hearts that have congenital defects or are damaged by disease such as rheumatic fever; situations that cause bacteremia.
Prevention and treatment	Administration of an antibiotic immediately prior to anticipated bacteremia, such as before dental work. Treatment: Bactericidal antibiotics given together, such as penicillin and gentamicin.

Septicemia

- Symptoms
    - Violent shaking chills and fever
        - Often accompanied by anxiety and rapid breathing
    - In case of septic shock
        - Urine output drops
        - Respiration and pulse become more rapid
        - Arms and legs become cool and dusky colored

Septicemia

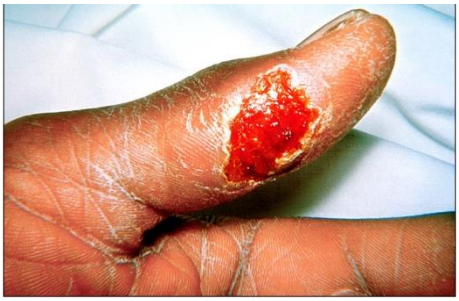
- Causative agent
    - Gram (-) bacteria more likely cause of fatal septicemia
    - Shock is common despite treatment
    - Mortality rate nearly 50%
    - Blood cultures from patients usually reveal
        - *E. coli* - Gram (-) facultative anaerobe
        - *Ps. Aeruginosa* - Gram (-) aerobe
            - Generally found in natural environment
        - *Bacteroides* sp. - Gram (-) aerobe
            - Part of normal intestinal and upper respiratory flora
- Pathogenesis
    - Generally originates outside of bloodstream
        - Alterations in normal body defenses may allow organism to infect blood
    - Endotoxin is released
        - Antibiotics can enhance endotoxin release
    - Macrophages respond intensely to endotoxin to try to localize
        - Exaggerated response considered hypersensitivity
    - Failed localization allows endotoxin into bloodstream
        - Causes cascade of harmful events
    - Lungs particularly susceptible to irreversible damage
        - Often results in death despite successful treatment of infection
- Epidemiology
    - Mainly a nosocomial disease
        - Reflects high incidence of Gram (-) bacteriemia in hospitals
    - General trend to increasing disease that relates to increased life span, antibiotic suppression of normal flora, use of immunosuppressive drugs and biofilm formation of medical devices
- Prevention and Treatment
    - Depends largely on identification and effective treatment of localized infections
    - Treatment against causative organisms
        - Treatment methods will vary according to infecting organism

Tularemia (Rabbit Fever)

- Symptoms
    - Characterized by development of skin ulcerations and enlargement of regional lymph nodes
    - Other symptoms include
        - Fever
        - Chills
        - Achiness
    - Symptoms usually abate in 1 to 4 weeks
        - Sometimes may become chronic
    - Mortality rate between 30% and 50%

Tularemia (Rabbit Fever)

- Causative agent - *Francisella tularensis*
- Pathogenesis
  - Causes ulcer at entry sight
  - Lymphatic vessels carry organism to regional lymph nodes
    - Become large, tender and filled with pus
  - Spread to other body sites via lymphatics and blood vessels
  - Pneumonia occurs in 10% - 15% of lung infections
    - Mortality rate as high as 30%
  - Multiplies within phagocytes
  - Cell mediated immunity responsible for ridding infection
    - 90% of infected individuals survive in the absence of treatment
- Epidemiology
  - Occurs among wild animals in Northern Hemisphere
  - In eastern U.S. most infections occur in winter
    - Result from skinning hunted rabbits
  - In western U.S. infections increase in summer
    - Due to bites from fleas and ticks
  - Other reservoirs for infection include
    - Muskrats, beavers, squirrels, and deer



- Prevention and Treatment
  - Uses of rubber gloves and goggles when working with animal carcasses
  - Insect repellents and protective clothing
    - Inspect routinely for ticks after exposure
  - Vaccine available for workers at higher risk of exposure
  - Treated with gentamicin

Symptoms	Ulcer at site of entry, enlarged lymph nodes in area, fever, chills, achiness
Incubation period	1 to 10 days; usually 2 to 5 days
Causative agent	*Francisella tularensis,* an aerobic, Gram-negative rod
Pathogenesis	Organisms are ingested by phagocytic cells, grow within these cells, and then spread throughout body.
Epidemiology	Present among wildlife in most states of the United States. Risk mainly to hunters, trappers, game wardens, and others who handle wildlife. Mucous membrane or broken skin penetration of the organism, as with skinning rabbits, for example; bite of infected insect or tick. Occasionally, inhalation.
Prevention and treatment	Vaccination for high-risk individuals; avoiding bites of insects and ticks; wearing rubber gloves, goggles, when skinning rabbits; taking safety precautions when working with organisms in laboratory. Treatment: gentamicin or ciprofloxacin.

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

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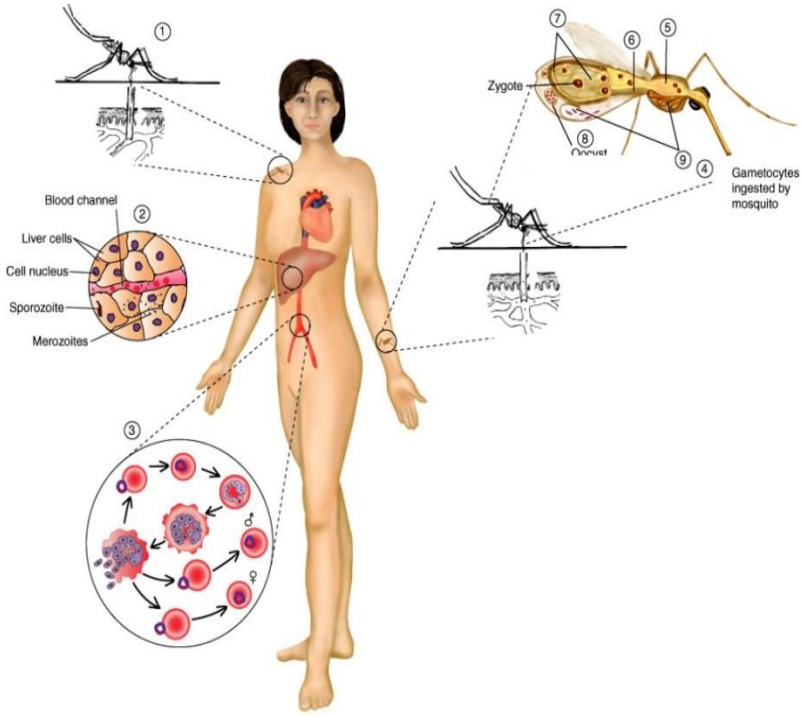
Yellow Fever

- Symptoms
  - Disease can range from mild to severe
  - Most common form may be only fever and slight headache lasting a day or two
  - Severe disease characterized by high fever, nausea, nose bleeds and bleeding into the skin, “black vomit” from GI bleeding and jaundice
  - Mortality rate of severe disease can reach 50%
  - Reason for the variation in symptoms is unknown
- Causative agent
  - Enveloped, single-stranded RNA arbovirus
    - Belongs to flavivirus family
  - Virus multiplies in mosquitoes
    - Mosquitoes transmit virus to humans
- Pathogenesis
  - Introduce via bite of *Aedes* mosquitoes
  - Multiplies and enters blood stream
    - Carried to liver
      - Jaundice results in liver damage
      - Injury to small blood vessels produces petechiae
  - Kidney failure is a common consequence of disease
- Epidemiology
  - Reservoir mainly infected mosquitoes and primates in tropical regions of Central and South America and Africa
  - Periodically spread to urban areas via mosquito bite
- Prevention and Treatment
  - Control achieved by spraying and elimination of breeding sites
    - Control almost impossible in jungle regions
  - Attenuated vaccine available for high risk groups
  - No proven antiviral treatment

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
- 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
- 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
- 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

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.