Chapter 23
Microbial Diseases of the Cardiovascular and Lymphatic Systems

Cardiovascular & Lymphatic Systems

- Plasma leaves blood to become interstitial fluid
- Lymph capillaries: Transport interstitial fluid to blood
- Lymph nodes contain:
  - Fixed macrophages
  - B cells
  - T cells

Cardiovascular & Lymphatic Systems

Bacterial Diseases

Sepsis and Septic Shock
- Septicemia
  - Persistent pathogens or their toxins in blood
- Sepsis
  - Systemic inflammatory response
- Severe sepsis
  - Sepsis + decreased blood pressure
- Septic shock
  - Sepsis + uncontrollable decreased blood pressure

Sepsis and Septic Shock
- Lymphangitis
  - Inflamed lymph vessels accompanying septicemia and septic shock

Gram-Negative Sepsis
- Endotoxin shock
  - Endotoxins cause blood pressure to decrease
- Antibiotics can worsen condition by killing bacteria
- Possible treatment
  - Human activated protein C, an anticoagulant

Gram-Positive Sepsis
- Nosocomial infections
  - Staphylococcus aureus
  - Streptococcus pyogenes
  - Group B streptococcus, S. agalactiae
  - Enterococcus faecium and E. faecalis

Puerperal Sepsis
- Childbirth fever
**Streptococcus pyogenes**
- Transmitted to mother during childbirth by attending physicians and midwives

11. **Bacterial Infections of the Heart**
- Endocarditis
  - Inflammation of the endocardium
- Subacute bacterial endocarditis
  - Alpha-hemolytic streptococci from mouth
- Acute bacterial endocarditis
  - *Staphylococcus aureus* from mouth
  - Pericarditis
  - Streptococci

12. **Bacterial Endocarditis**

13. **Rheumatic Fever**
- Inflammation of heart valves
- Autoimmune complication of *Streptococcus pyogenes* infections

14. **Tularemia**
- *Francisella tularensis*
  - Gram-negative rod
- Zoonosis
  - Transmitted from rabbits and deer by deer flies
  - Bacteria reproduce in phagocytes

15. **Brucellosis (Undulant Fever)**
- *Brucella* spp.
  - Gram-negative rods that grow in phagocytes
  - *B. abortus* (elk, bison, cows)
  - *B. suis* (Swine)
  - *B. melitensis* (goats, sheep, camels)
  - Undulating fever spikes to 40°C each evening
  - Transmitted via milk from infected animals or contact with infected animals

16. **Anthrax**
- *Bacillus anthracis*
  - Gram-positive, endospore-forming aerobic rod
- Found in soil
- Cattle routinely vaccinated
- Treated with ciprofloxacin or doxycycline

17. **Anthrax**
- Cutaneous anthrax
  - Endospores enter through minor cut
  - 20% mortality

18. **Anthrax**
- Gastrointestinal anthrax
  - Ingestion of undercooked, contaminated food
  - 50% mortality
  - Inhalational (pulmonary) anthrax
  - Inhalation of endospores
  - 100% mortality

19. **Biological Weapons**
- 1346: Plague-ridden bodies used by Tartar army against Kaffa
- 1937: Plague-carrying flea bombs used in the Sino-Japanese War
- 1979: Explosion of *B. anthracis* weapons plant in the Soviet Union
- 1984: *S. enterica* used against the people of The Dalles
- 1996: *S. dysenteriae* used to contaminate food
- 2001: *B. anthracis* distributed in the United States

**Biological Weapons**

**Gangrene**
- Ischemia: Loss of blood supply to tissue
- Necrosis: Death of tissue
- Gangrene: Death of soft tissue
- Gas gangrene
  - *Clostridium perfringens*, gram-positive, endospore-forming anaerobic rod, grows in necrotic tissue
  - Treatment includes surgical removal of necrotic tissue and/or use of hyperbaric chamber

**Systemic Diseases Caused by Bites & Scratches**
- *Pasteurella multocida*
- *Clostridium*
- *Bacteroides*
- *Fusobacterium*
- *Bartonella henselae*: Cat-scratch disease

**Cat-Scratch Disease**

**Vector-Transmitted Bacterial Diseases**

**Plague**
- Causative agent: *Yersinia pestis*, gram-negative rod
- Reservoir: Rats, ground squirrels, and prairie dogs
- Vector: *Xenopsylla cheopis*
- Bubonic plague: Bacterial growth in blood and lymph
- Septicemia plague: Septic shock
- Pneumonic plague: Bacteria in the lungs

**A Case of Bubonic Plague**


**Relapsing Fever**
- Causative Agent: *Borrelia* spp., spirochete
- Reservoir: Rodents
- Vector: Ticks
- Successive relapses are less severe

**Lyme Disease**
- Causative agent: *Borrelia burgdorferi*
- Reservoir: Deer
- Vector: Ticks
- First symptom: Bull's-eye rash
- Second phase: Irregular heartbeat, encephalitis
- Third phase: Arthritis

**Lyme Disease in the U.S., 2005**
Lyme Disease

**Ehrlichiosis and Anaplasmosis**
- Human monocytotropic ehrlichiosis (HME)
  - Causative agent: *Ehrlichia chaffeensis*
  - Gram-negative, obligately intracellular (in white blood cells)
  - Reservoir: White-tailed deer
  - Vector: Lone star tick
- Human granulocytic anaplasmosis (HGA)
  - Causative agent: *Anaplasma phagocytophilum*
  - Reservoir: Deer
  - Vector: Ticks

**Typhus**
- *Rickettsia* spp.
  - Obligate intracellular parasites
  - In endothelial cells of the vascular system
  - Arthropod vectors

**Typhus**
- Epidemic typhus
  - Causative agent: *Rickettsia prowazekii*
  - Reservoir: Rodents
  - Vector: *Pediculus humanus corporis*
  - Transmitted when louse feces are rubbed into bite wound

**Typhus**
- Endemic murine typhus
  - Causative agent: *Rickettsia typhi*
  - Reservoir: Rodents
  - Vector: *Xenopsylla cheopis*

**Spotted Fevers**
- Also called Rocky Mountain spotted fever
- Caused by *Rickettsia rickettsii*
- Measles-like rash, except that the rash also appears on palms and soles

**Rocky Mountain Spotted Fever, 1997–2002**

**Viral Diseases**

**Infectious Mononucleosis**
- Epstein-Barr virus (HHV–4)
- Childhood infections are asymptomatic
- Transmitted via saliva
- Characterized by proliferation of monocytes

**Burkitt’s Lymphoma**
• Epstein-Barr virus (HHV–4)
• Nasopharyngeal carcinoma
• Cancer in immunosuppressed individuals and in malaria and AIDS patients

43  **Cytomegalovirus Infections**
• Cytomegalovirus (HHV-5)
• Infected cells swell (*cyto-, mega-*)
• Latent in white blood cells
• May be asymptomatic or mild
• Transmitted across the placenta; may cause mental retardation
• Transmitted sexually, by blood, or by transplanted tissue

44  **Typical U.S. Prevalence of Antibodies**

45  **Viral Hemorrhagic Fevers**

46  **Viral Hemorrhagic Fevers**
• Marburg, Ebola, Lassa, Argentine and Bolivian hemorrhagic fevers, Whitewater Arroyo

47  **Viral Hemorrhagic Fevers**

48  **Protozoan Diseases**

49  **Chagas’ Disease**
• Also called American trypanosomiasis
• Causative agent: *Trypanosoma cruzi*
• Reservoir: Rodents, opossums, armadillos
• Vector: Reduviid bug

50  **Toxoplasmosis**
• Caused by *Toxoplasma gondii*
• Transmission:
  • Ingesting undercooked meat
  • Contact with cat feces
• Congenital infection
  • Stillbirth
  • Neurological damage

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52  **Malaria**
• Four major forms:
  • *Plasmodium vivax*
  • *P. ovale*
  • *P. malariae*
  • *P. falciparum*
• Vector: *Anopheles* mosquito
• Definitive host: *Anopheles* mosquito

53  **Malaria**

54  **Malaria in the United States**

55  **Malaria**
Malaria

- Prophylaxis
  - Chloroquine
  - Malarone: atovaquone and proguanil,
  - Mefloquine
- Treatment
  - Artemisinin: artesunate and artemether
- Control
  - Bed nets

Cutaneous Leishmaniasis

Leishmaniasis

Helminthic Diseases

Schistosomiasis

- Tissue damage (granulomas) in response to eggs lodging in tissues

Types of Schistosomiasis