

1  **Chapter 23**

Microbial Diseases of the Cardiovascular
and Lymphatic Systems

2  **Cardiovascular & Lymphatic Systems**3  **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

4  **Cardiovascular & Lymphatic Systems**5  **Bacterial Diseases**6  **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

7  **Sepsis and Septic Shock**

- Lymphangitis
 - Inflamed lymph vessels accompanying septicemia and septic shock

8  **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
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9  **Gram-Positive Sepsis**

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

10  **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

20 **Biological Weapons**

21 **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

22 **Systemic Diseases Caused by Bites & Scratches**

- *Pasteurella multocida*
- *Clostridium*
- *Bacteroides*
- *Fusobacterium*
- *Bartonella henselae*: Cat-scratch disease

23 **Cat-Scratch Disease**

24 **Vector-Transmitted Bacterial Diseases**

25 **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

26 **A Case of Bubonic Plague**

27 **U.S. Distribution of Plague, 1970–2004**

28 **Relapsing Fever**

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

29 **Lyme Disease**

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

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

31 32 **Lyme Disease**33 **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
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34 **Typhus**

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

35 **Typhus**

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

36 **Typhus**

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

37 **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

38 **Rocky Mountain Spotted Fever, 1997–2002**39 40 **Viral Diseases**41 **Infectious Mononucleosis**

- Epstein-Barr virus (HHV-4)
- Childhood infections are asymptomatic
- Transmitted via saliva
- Characterized by proliferation of monocytes
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42 **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**

56 **Malaria**

- Prophylaxis
 - Chloroquine
 - Malarone: atovaquone and proguanil,
 - Mefloquine
- Treatment
 - Artemisinin: artesunate and artemether
- Control
 - Bed nets
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57 **Cutaneous Leishmaniasis**58 **Leishmaniasis**59 **Helminthic Diseases**60 **Schistosomiasis**

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

61 **Types of Schistosomiasis**62