Ch 18
Infectious Diseases Affecting Cardiovascular and Lymphatic Systems
Part 2
Acute (Bacterial) Endocarditis

Usually caused by *S. aureus* → rapid destruction of heart valves with emboli formation

Parenteral route of transmission (e.g.: iv drug users)
Rheumatic Fever

Autoimmune complication of *S. pyogenes* infections.

Rheumatic fever can follow **strep throat**. Bacteria might not be present at time of rheumatic fever.

Pathogenesis: Antibodies against *S. pyogenes* crossreact with heart tissue.

Expressed as arthritis or heart inflammation.

Can result in permanent heart damage.

Prompt treatment of streptococcal infections can reduce the incidence of rheumatic fever.
Subacute Bacterial Endocarditis (SBE):

Preexisting valve abnormalities are predisposing factors.

Usually caused by \( \alpha \)-hemolytic streptococci from mouth (dentist!)

Signs may be similar to acute endocarditis but develop slower

Prophylactic antibiotic therapy for surgical and dental procedures
Streptococci on Blood Agar
**Septicemia**

Pathogens or their toxins persist (and proliferate) in blood

Signs: Fever, rapid HR and/or RR, WBC↑

**Causative agents:**

- **Gram-positive sepsis** - now most common, e.g.: MRSA, *S. agalactiae*, and *Enterococcus faecium* and *E. faecalis*

- **Gram-negative sepsis** - Antibiotics can worsen condition, why?

- Polymicrobial; ~ 10% fungal
Sepsis

Difference between septicemia, sepsis and bacteremia?

Puerperal sepsis = ______________________
causative agent: _________________________
Due to uterus infection following childbirth or abortion; can progress to peritonitis or septicemia
SEPSIS STEPS

SIRS
- T: >100.4 F
- < 96.8 F
- RR: >20
- HR: >90
- WBC: >12,000
- <4,000
- >10% bands
- PCO2 < 32 mmHg

2 SIRS + Confirmed or suspected infection

SEPSIS

SEVERE SEPSIS
- Sepsis + Signs of End Organ Damage
- Hypotension (SBP < 90)
- Lactate > 4 mmol

SEPTIC SHOCK
Severe Sepsis with persistent:
- Hypotension
- Signs of End Organ Damage
- Lactate > 4 mmol

Slide Courtesy Curtis Merritt, DO
“Black death”: *Yersinia pestis*, G- rod, bipolar staining

Endemic in Southwest → sylvatic plague

Reservoir: Rats, ground squirrels, and prairie dogs

Vector: infected fleas

- **Bubonic plague**: Bacterial growth in blood and lymph
- **Septicemic plague**: Septic shock
- **Pneumonic plague**: Bacteria in the lungs

15th Century Physician’s Plague suit
Femoral bubo: Most common site of tender, swollen lymph node in patients with plague.
The Black Death

History of Bioterrorism: Plague
(CDC Podcast)
Biological Weapons
Review Applications of Microbiology p. 654 (11th ed.) / 577 (10th ed.)

- **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
Lyme Disease

Zoonosis caused by *Borrelia burgdorferi*
Reservoir: mice, deer; Vector: *Ixodes* ticks

3 stages with various symptoms

1. **Early localized stage**: Bull’s eye rash = *erythema migrans*; flu-like symptoms
2. **Early disseminated stage**: Heart and nervous system symptoms; also skin and joints affected
3. **Late stage**: Chronic arthritis and some chronic neurological problems
Erythema migrans
Borrelia burgdorferi

- Large: 10 – 20 µm long
- Vector borne disease
Ixodes pacificus

Ixodes scapularis & Ixodes pacificus
Diagnosis
- Symptoms alone often lead to misdiagnosis
- In most cases not possible to isolate and culture *B. burgdorferi* → **indirect serological tests** (ELISA and Western blot)

PCR

Prevention

Treatment in early stages!

*Fig 18.16*
First Year

1. Newly hatched tick larvae become infected when they feed on small animals such as mice, which harbor the spirochete. The larvae continue development through this year.

2. In the second year the larvae molt into the nymph, an aggressive feeding stage.

Second Year

3. The nymph takes blood from a number of hosts, including deer and humans.

4. On deer, the nymphs mature into adult male and female ticks, which mate. The female lays eggs in plant litter, where they hatch and once again begin the cycle.
Infectious Mononucleosis

• “Kissing disease” – caused by **Epstein-Barr virus (EBV)** of *Herpesviridae*, also known as **HHV-4**

• Virus multiplies in parotid glands and is present in saliva. It causes the proliferation of atypical lymphocytes (life-long infection) – Transmission via saliva

• Most people (~95%) infected. Childhood infection usually asymptomatic. Adolescent infection → Mononucleosis.

• Characteristic **triad**: fever, pharyngitis, and cervical lymphadenopathy (also spleno- and hepatomegaly) lasting for 1 to 4 weeks.
Swollen lymph nodes, sore throat, fatigue and headache are some of the symptoms of mononucleosis. It is generally self-limiting and most patients can recover in 4 to 6 weeks without medications.
• Proliferation of infected B cells results in massive activation and proliferation of CD8 cells → characteristic lymphoid hyperplasia.

• Transformation of B cells to immortal plasmacytoid cells → secrete a wide variety of IgMs = **heterophile antibodies** (Monospot test)

• Commercially-available test kits are 70-92% sensitive and 96-100% specific

"Downy cell“: lymphocytes infected by EBV or CMV in infectious mononucleosis. Cytoplasmic rim is intensely blue and has tendency to "stream" around adjacent red cells.
**Viral Hemorrhagic Fevers**

**Classic hemorrhagic fevers**, caused by arboviruses:
- **Yellow Fever**: attenuated vaccine
- **Dengue Fever**: Also Caribbean

**Emerging Viral hemorrhagic fevers, e.g.**:
- **Chikungunya**: Endemic in Africa but has appeared in US and Europe - *Aedes* mosquitoes
- **Ebola**:
  - Endemic to Africa:
    - Capillary fragility is extreme and patients can bleed from their orifices and mucous membranes.
    - Bats are thought to be the natural reservoir of Ebola
- For some viruses human to human transmission
- Human cases or outbreaks sporadic and irregular. Not easily predictable
Ebola - 2014 Outbreak
Anthrax

*Bacillus anthracis* G+ rod, ES, aerobic, virulence factors: capsule, 3 exotoxins

Zoonosis; found in soil

Cattle routinely vaccinated

- **Cutaneous anthrax** – most common, ES enter through minor cut; 20% mortality, with antibiotics <1%

- **Pulmonary anthrax** – (woolsorter’s disease), Inhalation of ES; 100% mortality

- **Gastrointestinal anthrax** – Ingestion of undercooked contaminated food; 50% mortality

2001 anthrax attack: 22 infected, 5 died

6 vaccinations over 1.5 years and yearly boosters.
The type of illness a person develops depends on how it enters the body. All types of anthrax can cause death if they are not treated with antibiotics.

https://www.cdc.gov/anthrax/