Slide 1

Microbial Diseases of the Cardiovascular System

Lecture 25

Slide 2

Learning Outcomes

- Bacterial Diseases of Cardiovascular System
- Septicemia
  - Anthrax
  - Gangrene
  - Plague
- Viral Diseases of Cardiovascular System
  - Dengue

Slide 3

Septicemia

- Bacteria reproducing n blood stream
- If sepsis not treated rapid deterioration
- Fever, chills, accelerated breathing and heart rate
- Inflammatory molecules trigger a systemic drop in blood pressure
- Organ Failure
- Septic Shock
- Juan Pablo II

Slide 4

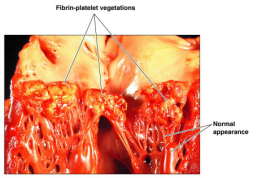
Septic Shock

- Gram Negative
  - Endotoxins
  - Less than 1 millionth gram endotoxin
  - Antibiotics
- Gram Positive Bacteria
  - Exotoxins
  - Superantigens
  - Toxic Shock Syndrome Toxin
- Enterococci
  - Penicillin and Vanconycin Resistance

Slide 5

Endocarditis

- Subacute bacterial endocarditis
- Alpha-hemolytic Streptococci
- Focal infection in teeth or tonsils
  - Body piercing
- Bacteria lodge in pre-existing lesions in heart valves due to
- rheumatic fever, syphilis, congenital defects
- Blood clots form on lesions protecting bacteria
- Heart murmur as valve function impaired



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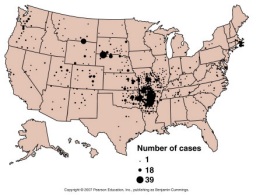
Tularemia

- *Francisella tularensis*
- Gram negative rod
- Zoonotic disease spread to humans from rabbits
  - Type A - North America
  - Type B -Europe
- Enters body via skin abrasions or ticks
  - Multiplies in macrophages
- 3% mortality
- Pneumonia
  - ID_{50} 1
- inhalation of dust contaminated by urine or feces 30% mortality
- Non-communicable between people



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Anthrax

- *Bacillus anthracis*
- Large, aerobic, endospore forming Gram positive rod
- Grows in soil and is contracted by grazing livestock
- Macrophages ingest endospores which germinate into vegetative cells, multiply and kill macrophage
- Edema toxin – causes swelling and inhibits phagocytosis
- Lethal toxin – targets and kills macrophages
- Both toxins possess protective antigen that binds them to target cells permitting entry
- Capsule composed of amino acid residues

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Forms of Anthrax

- Cutaneous – Hide Porters Disease
  - 90% of human cases
- Endospore enters skin abrasion
- Depressed ulcer covered by a black eschar
- Bacteria do not enter blood

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Bacillus anthracis

Portal of entry	ID_{50}
Skin	10-50 endospores
Inhalation	10,000-20,000 endospores
Ingestion	250,000-1,000,000 endospores

Other Forms of Anthrax

- Inhalation – Wool Sorter's Disease
  - Inhaled endospores enter the bloodstream
  - Mild early flu-like symptoms
  - After 2-3 days Septic shock and death within 24 to 26 hours
  - Mortality rate ~100%
- Gastrointestinal
  - Via consumption of endospores in undercooked meat
  - Ulcers occur in GI tract
  - Mortality > 50%

Gas Gangrene

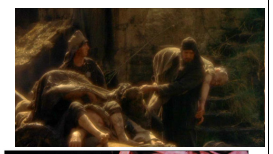
- *Clostridium perfringens*
- Gram + endospore forming obligate anaerobe
- Ischemia, the interruption of blood to tissues caused by a wound, or diabetes, leads to necrosis
- Lack of oxygen permits germination of endospores found in soil
- Growth in muscles
  - myonecrosis

Gas Gangrene Pathenogenicity

- Ferment carbohydrates from dead tissue → gases accumulate
  - CO_2 and N_2 and H_2
- Enzymes degrade collagen and proteins
- Toxins diffuse to tissues killing cells spreading necrosis
- Alpha toxin
- Treatment surgical removal of necrotic tissue and amputation

Plague

- *Yersinia pestis*
- Gram negative rod
- Zoonosis transmitted to humans from rats by rat flea *Xenopsylla cheopis*
- Bacteria proliferate in blood and lymph
- Multiply inside phagocytes
- Bubonic Plague
- buboes swelling of lymph nodes
  - 80-95% of cases
  - 50-75% mortality if untreated
- Pneumonic Plague transmitted from humans via respiratory route ~ 100% mortality
- Nostradamus



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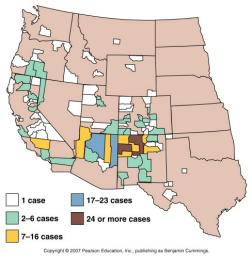
Plague in the South West

- Animal reservoirs
- ground squirrels and prairie dogs domestic cats and dogs
- Endemic to four corners area
- Gradually spreading throughout West
- Cases of plague since 1970
- In 2003 9 countries reported 2118 cases and 182 deaths mostly in Africa



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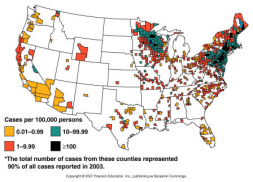
Lyme Disease

- 1975 Lyme, Connecticut
- 1983 *Borrelia burgdorferi* spirochete identified
- Deer ticks Ixodes spp are vector
- White-footed Mouse primary animal reservoir
- Tens of thousands of cases annually in US most in East Coast
- Most common tickborne disease in USA



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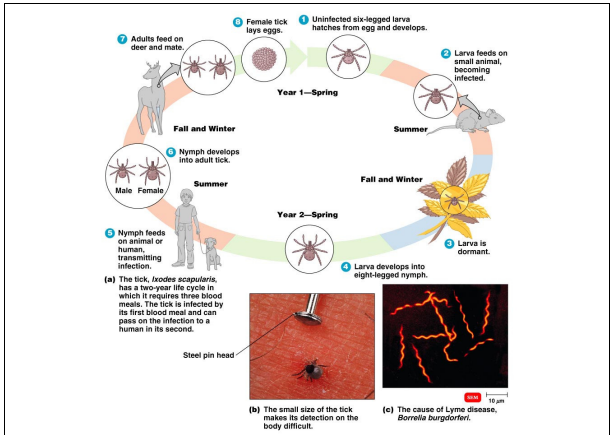

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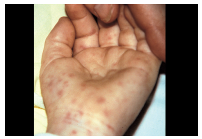
Epidemic Typhus

- Obligate intracellular bacteria
- *Rickettsia prowazekii*
- Vector and reservoir; Human Louse
- Bacteria in louse feces scratched into bite wound by host
- Responsible for death of 8000 of Napoleans troops in failed Russian Campaign

Rocky Mountain Spotted Fever

- Rickettsia rickettsii
- *Dermacentor* sp ticks reservoir and vector
- Transovarian passage
- Endemic in Southern US
- 1 in every 1000 ticks infected
- Macular rash on palms and soles of feet
- 1000 cases per year
- 3% mortality due to kidney failure



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Dengue

- *Aedes aegypti* Mosquito borne
- Endemic to Caribbean and Central America, other tropical nations
- 100 million cases per year worldwide
- Fever, muscle and joint pain, and rash
- Dengue Hemorrhagic Fever
- Severe form when antibodies from a previous infection combine with virus

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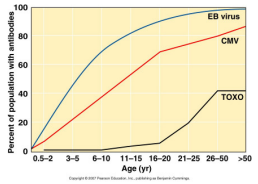
Infectious Mononucleosis

- Childhood infections usually asymptomatic
- If infection occurs during adolescence symptoms occurs due to immunologic response (T cells)
- Recovery after a few weeks
- Contracted via oral route direct or indirect contact
- Infect B cells which develop unusual lobed nuclei



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Toxoplasmosis

- Cyst forming protozoan *Toxoplasma gondii*
- Zoonosis cats are and rodents reservoirs
- In humans mostly a mild or asymptomatic infection
- 4000 cases US per year
- Congenital infection of fetus results in stillbirths, brain damage, visual impairment
- Only when mother's first exposure is during pregnancy
- Bad Kitty

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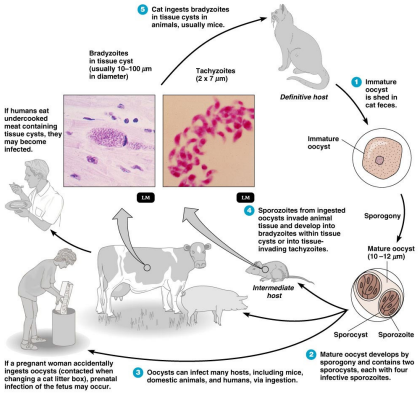

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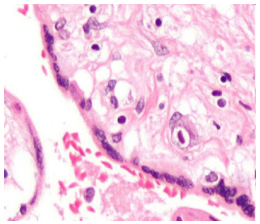
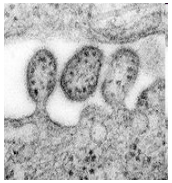
TORCHES

- Transplacental infections
- Toxoplasmosis
- Other
- Rubella
- Cytomegalovirus
- HErpes Simplex
- Syphilis
- Where other includes: HIV, Hepatitis B, HHV-3, cocksackie virus



Emerging Viral Hemorrhagic Fevers

- Marburg
- Lassa Fever
- Ebola
- Bolivian Hemorrhagic Fever
- Whitewater Arroyo Virus
- Hantavirus