Spirochetes

Gram -- organisms with unique structure and motility, most are free-living, but several human pathogens included
Biology of Spirochetes

• Long slender, flexible helical shape
  – many so thin cannot be seen without darkfield microscopy

• Axial filament
  – periplasmic flagella (endo-flagella)
  – outer sheath with few antigens
    • avoids immune detection
  – extremely motile
    • by flexing of sheath due to rotary action of endo-flagella

Treponema
Leptospira
Borrelia
Spirochetes, continued

- May be anaerobic, aerobic, microaerophilic
- Ubiquitous: from mud to mouths
- Many are pathogens in humans
  - Syphilis
  - Lyme disease
  - Weill's Disease
  - Yaws, pinta, etc.
Syphilis

- *Treponema pallidum*  
  - similar organisms cause  
    pinta, bejel, yaws
- can infect any organ and tissues
- 3 distinct phases  
  - the “Great Imitator”  
  - more pathogenic in past  
  - Major killer before penicillin  
  - Still a major disease  
  - Crosses placenta  
  - Wassermann test  
    - public health law!

Treponema pallidum in tissues
The course of untreated syphilis

- **Primary chancre**: 10–90 days after exposure
- **Secondary eruptions**: 3–8 weeks after exposure
- **Recrudescent secondary eruptions**: 4–12 weeks after exposure
- **Early latent stage**: 2 years after primary chancre
- **Late latent stage**: 10 years after primary chancre
- **Tertiary stage**

Serologically positive
Epidemiology of syphilis

- Cannot be cultured
- humans only infected
- Rich history
  - 16th Century, 25% mortality
  - the Great Pox*
  - major cause of mortality in 1940s
  - 1990s about 130,000 cases per year
  - environmentally unstable
    - *as opposed to small pox
- venereal transmission
  - nonsexual is rare
- Congenital syphilis
- penetrates mucus membranes but not skin
- rapidly spread in body
- lesions due to immune response**
  - prevents reinfection but not pathogenesis
Primary syphilis

- Chancre, 10-90 days after infection (21 ave.)
  - “hard chancre”, with induration
- ulcer is solitary, painless
- Generally found on genitalia, cervix, mouth, anus, etc.

- The Chancre:
  - lasts 3-6 weeks
  - teeming with organisms
  - highly infectious
  - lymphadenopathy
    - lasts for months
- Homosexual males reservoir for-
  - lesion is usually in anus, and is painless
Primary chancre on face
Secondary syphilis

- Generally 2-6 weeks after 1\textdegree{} lesion
- mucocutaneous lesions & generalized symptoms
  - fever, malaise, sore-throat, headache, etc.
  - mimic measles, psoriasis, condylomata lata looks like hemorrhoids
  - liver infection looks like hepatitis
  - Latent syphilis
    - lasts for years
Tertiary syphilis

- 2 to 20 years later
  - 30% of untreated cases become tertiary
- CNS & cardiovascular
  - syphilis dementia
  - aneurysms & valvular incompetence
- Gummas
  - granulomas of any tissue
    - due to delayed CMI
    - progressively destructive to heart, brain, death!!
  - AIDS & neurosyphilis
- Treatment
  - penicillin, malaria, Borrelia?
Congenital syphilis

• Crosses placenta in 1°, 2° & latent stages*
  – (must be in blood)
• affects joints, bones, cartilage of nose
  – saddle nose, Hutchinson’s teeth & saber shin
• spontaneous abortions common
Yaws

Skin lesions of yaws

Destruction of tibia

Gangosa, destruction of maxillary & palate
Yaws, Bejel, and Pinta are caused by essentially the same organism that causes Syphilis, but is not sexually transmitted.

Gummatous Bejel
**Borrelia recurrentis, et al.**

- **Relapsing Fever**
  - Tick-borne (endemic)
    - Argasidae (soft ticks)
  - Louse-borne (epidemic)
    - *Pediculus humanus*

- **cardinal signs:**
  - high fevers (no LPS), icterus, tachycardia, myalgia, splenomegaly
  - 6-9 days with relapses 4-7 days

- **Antigenic variation**
  - causes relapses

- **Relapses continue until cure or death**

- **Tetracycline, or erythromycin**

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**Coxial fluid swarming with spirochetes**

**Pediculus humanus, body louse**
The Pattern in Relapsing Fever. Figure 21.10 (T)

- (1) First antigenic challenge
- (2) First antibody response
- (3) Second antigenic challenge
- (4) Second antibody response
- (5) Third antigenic challenge
- (6) Third antibody response

Temperature in °C:
- Normal temperature: 37
- Core temperature: 38, 39, 40, 41
Lyme Disease

- Emerging disease in USA:
  - Caused by *B. burgdorferi*
  - Tickborne (deer tick)
  - First cases in Old Lyme, CT, in 1975
  - Initially, flu-like symptoms and circular rashes (erythema migrans) around the bite site.
  - **5-15%** have neurologic or cardiac involvement
  - **Chronic** poly-artralgias and myalgia with fevers, may last for years
  - Antigenic variation!!
  - Treatment with penicillin or tetracycline

Old Lyme, Connecticut
Former farm lands now suburban living space
Life-cycle of Lyme Disease

Human (accidental host)

Infected nymph

Mouse infected with *Borrelia burgdorferi*

Borrelia spirochetes

Larval tick

Eggs hatch

Complete development

Deer

Adult ticks

Female

Male
Figure 17-8  Reported cases of Lyme disease in the U.S. from 1982 through 1994.
Incidence of Lyme Disease, 1994
Deer tick nymph taking blood meal

Initial lesion

B. burgdorferi

Erythema migrans
Leptospirosis, Weil’s Disease

- *L. interrogans*, a zoonosis that infects kidneys, liver
  - icteric is highly fatal also
  - anicteric form, less serious
  - Large # bacteria are passed in urine
- Infection via urine
  - common in sewer workers
  - May induce kidney failure & death
- Penicillin, tetracycline
- Jaundice and subconjunctival hemorrhages of leptospirosis
- temporary renal dialysis
- Prevent by limiting exposure to urine
Leptospirosis, Weil’s Disease

- Jaundice due to liver damage
- Conjunctival hemorrhages in Weil’s
Leptospirosis in USA