Treponema & Borrelia

General

- Anaerobic or microaerophilic
- Helical, tightly coiled
- Hard to cultivate in the laboratory
- The majority of Treponema species are normal flora in the oral cavities, genital tract, or rumen of animals
- A few species are pathogenic
- Motile: periplasmic flagella
General

Promote evasion of the immune system

Antigenically inert surface

extremely low density of surface-exposed transmembrane proteins

Treponema pallidum ssp. pallidum

- An important human pathogen causing syphilis
  - 12 million new cases of syphilis per year (WHO, 1999)

- Highly invasive
  - Can invade directly through mucous membranes or through abraded skin

- Transmission
  - Sexual contact
  - Can be transmitted to the lips via kissing
  - Can be transmitted to physicians or pathologists who do not take adequate precautions
  - Transplacental transmission is also common
Treponema pallidum ssp. pallidum: Disease stages

**Primary stage**
- The development of a chancre at the site of entry of the organism
  - These lesions are typically single
  - not painful
  - have a raised border
  - reddish in color
- Large numbers of organisms can be shed from these lesions
- 100% cure rate if treated at this stage
- The organisms move from mucous membranes to the bloodstream to develop the secondary syphilis
Treponema pallidum ssp. pallidum: Disease stages

- **Secondary stage**
  - 2-10 weeks after the development of the primary lesion
  - This stage is characterized by fever, sore throat, headache and rash: The rash can occur on the palms and soles
  - Without treatment
    - enters a period of latent disease

  **Congenital syphilis**
  - Most likely to occur when the infection is active during the primary and secondary stages
  - Occurs in about 2% of infected pregnant females
  - The organism becomes widely disseminated in the fetus
    - cause abortions or severe physical and mental deformities

Treponema pallidum ssp. pallidum: Disease stages

- **Tertiary stage**
  - Characterized by the formation of localized lesions of the skin called "gummas"
  - Develops 3-10 years after the secondary stage
  - The organism invades cardiac muscle, musculoskeletal systems and the central nervous system
    - Neurosyphilis may mimic other neurologic diseases
    - Cardiovascular syphilis may occur 10 to 40 years following primary disease
Diagnosis

- Direct examination of lesion material
  - Darkfield microscopy
  - Fluorescent antibody test
- VDRL (Venereal Disease Research Laboratory) Test
  - Looking for anti-cardiolipin Ab not anti-treponemal Ab in a patient’s serum
    - Cardiolipin - a phospholipid present in mitochondrial membrane serologically active in the presence of lecithin
  - It is not known cardiolipin is from *T. pallidum* or the host

- Treatment: Penicillin is effective, if allergic, Tet or Ery

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**Treponema paralium-cuniculi**

- The cause of “rabbit syphilis”
  - The lesions are usually confined to the genital region, but the lips and eyelids may be involved
  - Occur in both sexes
- Transmission
  - Venereally
  - Not transmissible to humans or other domestic animals
- Diagnosis
  - Clinical signs
  - VDRL test
    - Darkfield microscopy
- Treatment
  - Penicillin (weekly intervals for 3 wk)
  - Necessary to treat the whole rabbits to eradicate from a herd
Treponema brennaborense

- Isolated from cattle with “bovine digital dermatitis” in 1999

- **Bovine digital dermatitis**
  (Papillomatous digital dermatitis, Hairy foot wart)
  - An acute or chronic inflammatory disease in interdigital space of the bovine foot (common on the hind feet)
  - Loss of keratin, pain and swelling \(\rightarrow\) lameness
  - At slaughter in the US, 29% of the dairy cattle had lesions of digital dermatitis
  - Spread rapidly within affected herds

- Its pathogenesis is unknown

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**Treponema brennaborense**

- **Diagnosis**
  - Observation of typical lesions common in interdigital space
  - Detection of spirochetes with FA

- **Treatment**
  - Penicillin and ceftiofur
  - Topical dressing with soluble oxytetracycline or lincomycin-spectinomycin
  - Footbath containing topical applications or zinc sulfate
  - Large, chronic foot warts \(\rightarrow\) Surgical removal

http://www.coppersulfatecrystals.com/footbath.html
May cause digital dermatitis in other animals too?
- Treponema phagedenis-like
- Treponema medium-like
- Treponema vincentii-like

Treponema

T. pallidum ssp. pallidum  T. paraluis-cuniculi  T. brennaborense

Syphilis  Digital Dermatitis
Treponema & Borrelia

General

- Obligate parasite in a variety of vertebrate hosts
- All of the species are transmitted by ticks and lice
- Morphology
  - Longer and wider than other spirochetes
    - Has fewer coils
  - Motile by periplasmic flagella

B. burgdorferi in the ear of mouse
**B. burgdorferi**

- Causes Lyme disease
- **Transmission**
  - Transmitted by several tick species (mainly *Ixodes* species)
  - The tick feed on an infected animal
    - Pass the organism to the multiple life cycle of tick
    - Transmit the organism to any hosts that it feeds on, including deer, humans, dogs, horses, and cattle

![Blacklegged (Deer) tick](image1)

**B. burgdorferi: Ticks**

- **Blacklegged tick: nymph**
- **Blacklegged tick: female adult**

http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php
**B. burgdorferi: Lyme disease**

- First identified in Lyme County, Connecticut, US, in 1975
- Occurs primarily in summer

- Characterized initially by a distinctive skin lesion “erythema migrans” in approximately 80% of infected individuals
- Symptoms (such as fever, headache, joint pain, etc.) occur as long as 1 month after the tick bite → can delay diagnosis
- Can cause arthritis, neuritis, and cardiac complications, it can be fatal, but fatalities are low
- **Treatment:** tetracycline and penicillin
- **Vaccines:** Available for dogs,
  - The only human vaccine LYMErix (GlaxoSmithKline) was quietly pulled off the market in 2002
**B. burgdorferi:** Veterinary significance

- *B. burgdorferi* causes a tick-transmitted inflammatory joint disease of dogs and cattle, and possibly horses

**In dogs**
- Lameness, fever, lethargy, with or without swollen lymph nodes
- Does not develop erythema migrans
- Renal, cardiac, and neurologic forms
- Generally fatal
- **Diagnosis:** Clinical signs: swollen and painful joints and fever
  - ELISA, PCR
- **Treatment:** Tetracycline (doxycycline) and penicillin (amoxicillin) are effective

- In endemic areas, young dogs should be “vaccinated” before natural exposure to ticks

**B. anserina**

- Cause avian spirochetosis
  - Chickens, ducks, turkeys, geese primarily in young birds
  - Worldwide distribution, but not very common in the US

- **Disease**
  - Acute septicemia with fever, diarrhea, drowsiness
  - Enlargement of spleen
  - Usually starts with green or yellow diarrhea
  - Young birds are more severely affected
  - Mortality: 33-77%

- **Transmission:** Via bites of ticks, mainly *Argas persicus* (fowl tick)

- **Diagnosis:** Can be cultivated in chicken embryos
  - Direct examination by darkfield microscopy

- **Treatment:** Penicillin, tetracycline, kanamycin and streptomycin

- **Prevention:** Tick control

- **Vaccination:** Bacterins work successfully
**B. theileri**

- Cause **bovine borreliosis**: septicemia/fever
- Caused by “lone star tick”
- Often seen in Australia and Africa

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**Lone Star Tick**

Female ▶ Male

The female is distinguished from any other tick by her white dot or star in the center of her back

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**Species & Disease**

<table>
<thead>
<tr>
<th>Species</th>
<th>Vector</th>
<th>Host</th>
<th>Clinical conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. burgdorferi</em></td>
<td><em>Ixodes</em> species</td>
<td>Rodents</td>
<td>Arthritic, renal, cardiac and neurologic disease in <strong>dogs</strong>, occasionally in horses, cattle, sheep and humans</td>
</tr>
<tr>
<td><em>B. anserina</em></td>
<td><em>Argas</em> species</td>
<td>Birds</td>
<td>Avian spirochetosis, fever, weight loss and high mortality in young birds</td>
</tr>
</tbody>
</table>
| *B. theileri*   | Many tick species | Cattle, sheep, horses | Bovine borreliosis  
**Mild, febrile disease with anemia** |