Brachyspira & Lawsonia

General
- Gram-negative
- Anaerobic but with aerotolerance
- Colonize the large intestine of mammals and birds
- Infections with Brachyspira species are important in pigs

Species & Disease

<table>
<thead>
<tr>
<th>Species</th>
<th>Hosts</th>
<th>Disease</th>
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<tbody>
<tr>
<td>B. hyodysenteriae</td>
<td>Pigs</td>
<td>Swine dysentery</td>
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<tr>
<td>B. pilosicoli</td>
<td>Pigs, poultry, humans</td>
<td>Colonic spirochetosis</td>
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<tr>
<td>B. aalborgi</td>
<td>Humans, primates</td>
<td>Colonic spirochetosis</td>
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<tr>
<td>B. alvinipulli</td>
<td>Poultry</td>
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<tr>
<td>B. intermedia</td>
<td>Poultry</td>
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B. hyodysenteriae: Swine dysentery
- Originally named Treponema hyodysenteriae
  → changed to Serpulina hyodysenteriae
  → changed to Brachyspira hyodysenteriae in 1997

- Causes swine dysentery
  - A severe mucohemorrhagic diarrhea with extensive inflammation and epithelial necrosis in the large intestine
  - Historically the disease was thought to be caused by vibrio, so some people still call it “vibrionic dysentery”
**B. hyodysenteriae:**

**Swine dysentery**

- Pigs of any age may be affected
  - Uncommon in neonates
  - Primarily in grower or finisher pigs

- Ingestion of the organism
  - An incubation period of about 7-10 days
  - The disease first starts as a diarrhea
    - Appearance of jelly-like mucus in the feces
  - Pigs shed blood in the feces
    - The fecal material may become very watery and bloody

- Pigs become dehydrated and profoundly weak
- Some pigs die

**B. hyodysenteriae:**

**Transmission**

- Pig to pig via the fecal-oral route
- The organism can be carried on boots, by birds, flies, dogs, and rodents

- After recovery, asymptomatic pigs can excrete the organism in feces for 3 months or more

- The organism is susceptible to disinfectants, heat and drying
- Environmental survival is usually short (1 or 2 days), but organic material protects the organism from desiccation and disinfection (may survive in lagoons as long as 1 year or more)
- The organism can be very difficult to get out of a swine unit

**B. hyodysenteriae:**

**Virulence factors**

- Two bundles of 7-13 periplasmic flagella
  - Highly motile
  - Facilitate colonization of the deep crypts within the large intestine
- Flagellar mutants are avirulent in pigs

- Strong ß-hemolysis
- Differentiates *B. hyodysenteriae* from other *Brachyspira* species

- Dysentery cannot be produced in germ-free pigs
  - Implication of other intestinal flora in the disease

**B. hyodysenteriae:**

**Diagnosis**

- Signs may be similar to other types of enteritis (salmonellosis)
  - Demonstration of the organism in lesions is needed
- Mucosal scrapings from large intestine, or feces can be used

- **Culture**
  - Grow very slowly
- Selective media containing blood, swine fecal extract and antibiotics (such as spectinomycin and rifampin)

- **Biochemical tests**

<table>
<thead>
<tr>
<th>Species</th>
<th>ß-hemolysis</th>
<th>Indole</th>
<th>Hippurate hydrolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. hyodysenteriae</em></td>
<td>Strong</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td><em>B. pilosicoli</em></td>
<td>Weak</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
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<tr>
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<td>+</td>
<td>-</td>
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- **PCR:** detection of the organism in feces or mucosal scraping
**B. hyodysenteriae: Treatment**

- **Vaccination**
  - A commercial vaccine (whole cell bacterin) is available
  - May reduce clinical signs but does not prevent the infection
  - Effective commercial vaccines are not currently available

- **Treatment**
  - Medicate drinking water with lincomycin, virginiamycin, tylosin, gentamicin, or carbadox (banned in Canada and EU)
    - But, antibiotic-resistant strains are prevalent
  - Mice are an important reservoir of infection
  - Elimination/reduction of mice on the farm

**B. hyodysenteriae Story Time**

Even after recovery, shed the organism for about 3 months

- Fecal-oral
- Disease in the large intestine
- Swine dysentery (Watery, bloody diarrhea)
- Weigh loss

**Brachyspira pilosicoli**

- **General**
  - Colonize the large intestine of various species, such as pigs, chickens and humans
  - Causes intestinal spirochetosis
  - A weakly beta-hemolytic intestinal spirochete

- **Morphology:** Identical to *Brachyspira hyodysenteriae.*

**Brachyspira pilosicoli**

- **Pigs**
  - Produces a diarrheal disease
    - Can occur to pigs of any age
    - Most commonly seen in the immediate post-weaning period

- One end of the bacterial cell attaches the colonic epithelium (20-80 spirochete cells per enterocyte)

- The major clinical signs: weight loss, poor growth rate, and diarrhea with occasional flecks of blood.

- Produce a milder disease than *B. hyodysenteriae*

- **Treatment:** lincomycin
**Brachyspira pilosicoli**

- **Humans**
  - Human intestinal spirochetosis
  - Characterized by the end-on attachment of large numbers of the organism
  - The disease is most commonly seen in people in less developed countries and AIDS patients
  - Commonly associated with rectal bleeding and chronic diarrhea
  - Animal isolates are similar to human isolates
  - \( B. \) pilosicoli is likely to be "zoonotic"

- **Treatment:** clindamycin and macrolides

**Brachyspira & Lawsonia**

**Before start**

<table>
<thead>
<tr>
<th>Order</th>
<th>Spirochaetes (Spirochetes)</th>
<th>Brachyspirocaea</th>
<th>Leptospiraceae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus</td>
<td>Brachyspira</td>
<td>Treponema</td>
<td>Leptonema</td>
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<tr>
<td>Genus</td>
<td>Spinilis</td>
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<td>Genus</td>
<td>Spironema</td>
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- **What's the family of **Lawsonia**?**

1. **Order:** Desulfovibrioiales
2. **Family:** Desulfovibrionaceae
**Lawsonia intracellularis: General**

- *L. intracellularis* is the sole species in the genus *Lawsonia*
- Curved, vibrio-like, Gram-negative
- Microaerophilic
- Obligate intracellular organism:
  - Survives intracellularly in the epithelial cells of the “ileum”
  - Has not been cultivated using artificial media
- A single unipolar flagella

**Lawsonia intracellularis: Proliferative enteritis**

- Other names: wet-tail disease, intestinal adenomatous hyperplasia, and ileitis
- Adenomatous proliferation of immature enterocytes → “thickens the intestinal mucosa”

**Pigs**
- A common diarrheal disease in pigs (2-12 months)
- Lesions develop mostly in the “ileum”
- Two-forms of proliferative enteritis
  1. Acute: Proliferative hemorrhagic enteropathy
     - Characterized by hemorrhage from thickened mucosa
  2. Chronic: Chronic mild diarrhea
     → reductions in rate of weight gain

**Ileum showing thickened mucosa with coagulated blood**
Lawsonia intracellularis: Proliferative enteritis

- Pigs with dark red-black diarrhea feces
- The farmer may find a dead pig with dark red-black diarrhea

Lawsonia intracellularis: Transmission & Virulence Factors

- **Transmission**
  - The source of infection has not been determined
  - Feces from infected pigs may be the source of new infections
  - Pig-to-pig contact is an important route of transmission
  - Boots, mice, birds, insects may carry the organism

- **Virulence factors** – Not characterized well
  - Attachment and invasion into epithelial cells
  - Able to escape from the membrane-bound vacuole
    - Free-living in the cytoplasm
  - Infected enterocytes proliferate, but mechanisms are not known
  - Inoculation into gnotobiotic pigs does not cause the disease
    - Intestinal flora may contribute to development of the disease

Lawsonia intracellularis: Other Animals

- **Foals**
  - There has been a marked increase in isolation of *Lawsonia intracellularis* from foals
  - Foals 3-7 months of age are most commonly affected but older horses can also develop disease
  - Chronic mild diarrhea and weight loss
    - The foals are often in poor physical condition

- **Other hosts reported**
  - Hamster, rabbits, rats, sheep, dogs, birds, nonhuman primates, but so far "no humans"

Lawsonia intracellularis

- **Diagnosis**
  - Growth of this organism must be done in tissue culture since it is an obligate intracellular parasite
  - Bacterial detection by immunohistochemical staining, ELISA, immunofluorescence test, and PCR

- **Treatment:** A number of antibiotics (tetracyclines, tylosin) have been used successfully

- **Vaccination:** Live-attenuated vaccines are currently being marketed that have good efficacy