**Spirochetes**

- **Class Spirochaete**
  - *Brachyspira hyodysenteriae* – Swine (Winter) Dysentery
  - *Borrelia burgdorferi* – Lyme Disease
  - *Treponema spp.*
    - *T. brennaborense* – (Hairy foot wart) Bovine papillomatous digital dermatitis
    - *T. paraluis-cuniculi*: rabbit syphilis (vent disease)
    - *T. pallidum subsp. pallidum* – human syphilis
  - *Leptospira spp.*

**General Characteristics**

- G-ve (stain poorly), Giemsa
- Fastidious – specialized media,
  - *Brachyspira hyodysenteriae* – anaerobic
  - *Borrelia burgdorferi* – specialized media, 6 weeks
  - *Leptospira* – EMJH liquid media (long culture times)
- Motile (endoflagella)
- Conventional Dx:
  - typically Phase/dark field microscopy,
  - FAT/ Ab-based agglutination testing

*Brachyspira* ~ 15 uM
*Borrelia* ~ 20 uM
*Leptospira* 6-12 uM
**Brachyspira hyodysenteriae: Swine Dysentery**

- **Virulence Factors:**
  - Colon goblet cells
  - Variable surface proteins (Vsps)
  - Two hemolysins, iron-storage system
  - Mucin is chemoattractant
  - Lipooligosaccharide (LOS)

- **Pathogenesis:**
  - Fecal-oral (swine carriers, rodents)
  - Synergy with gut commensals to cause disease
  - Invade colon goblet cells (no bacteremia)

- **Signs:**
  - 6-12 wk/old pigs, 30-50% morbidity, low mortality
    - Initially
      - Watery diarrhea, dehydration
      - Loss of body condition, emaciation
    - During recovery
      - Mucohemorrhagic diarrhea
      - Fully recover or remain stunted & with chronic diarrhea

**Intestinal Spirochaetosis**

- **Diagnosis**
  - Direct examination – **not definitive**
    - Centrifuged fecal sample – phase contrast
  - PCR – surveillance/ante- & postmortem
    - Rectal swabs, feces, intestinal contents
    - Largely replaced microscopy
    - Pooled rectal swabs from weaner-pigs

- **Intervention – Depop-sanitation-repop**
  - Biosecurity
    - Replacement stock
    - Rodent/bird control, trucks, people
  - Abx in feed
    - Tiamulin or Lincomycin
  - No vaccines in Canada

- **B. pilosicoli**
  - Swine
    - As prevalent as Swine Dysentery
    - Milder signs – no dysentery
  - Poultry, dogs & humans

**Swine Dysentery**

- **Thickened intestinal folds due to colon-crypt enterocyte proliferation**
- **Fibrinous, ulcerative colitis proliferation**
**Borrelia spp. : Overview**

- **Biggest** of the spirochetes, **linear chromosome**, fastidious (culture not usually done)
- **Tick vectors**

- **Borrelia burgdorferi**
  - Broad group name → encompasses 13 spp. including B. burgdorferi

- **B. theileria** – bovine borreliosis
  - Septicemia but mild fever, anemia

- **Borrelia anserina** – Avian Spirochetosis
  - Not common in N.A., Tick trans'n (Argas persicus: fowl tick)
    - septicemia, fever, weight loss, anemia

- **Borrelia coriaceae** – Epizootic Bovine Abortion
  - "Foothills abortion", Western US

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**Tick Talk: and Wikipedia..?**

- *Ixodes scapularis*, deer tick.
- *Ixodes pacificus*, Western Black-legged tick.
- *Amblyomma americanum*, or lone star tick, is a species of tick in the genus *Amblyomma*. Wikipedia, 08,2012.
Lyme Disease: What’s...this...ruckus?

- Canines (horses, cattle)
- 95% of dogs asymptomatic
- 5% tend to be puppies
  - fever, anorexia, arthritis (relap-recur)
  - Lyme-Associated Nephropathy (?)

- Dx – culture not usually done
  - rarely found in blood, urine, joint fluid or CSF
- Fastidious
- Serology – VlsE C6 peptide
  - “Dog-side” qualitative test
  - Quantitative C6 ELISA

- Intervention
  - Tick Control (K9 Advantix)
  - Doxycycline or Amoxicillin
  - Vaccines – OspA (kills Bb in tick)


- Humines... u know what I mean?
- 90% show clinical disease
- Typically acute
  - Flu-like symptoms
  - Cardiac signs
  - Borrelia neuropathies
  - Acute & Chronic Manifestations
    - Central and/or peripheral

- Doxycline or Ceftriaxone

Leptospira: Overview & naming

- Gram-negative but: thin (0.2 uM), do not Gram stain
  - 6 - 12 uM long, bipolar endoflagella, 2 circular chromosomes
  - remain viable in aquatic environments or urine-saturated soil
  - Infections: asymptomatic & chronic or acute with severe clinical signs

- Serovars/genomospecies ... specivars??
  - Historically two species & ~300 serotypes
  - Serovars – based on O-Antigen (LPS) profiles

- Genotyping (1991)
  - Correlated well with serovar criteria
  - ie. pathogenics clustered, non pathogenics clustered etc.

- Now (2012) – composite of genomospecies & serovar
  - L. interrogans – majority of pathogens
  - > 200 serovars & the serovar name is used with Genus name

Naming example
- L. Canicola
Transmission – direct/indirect & zoonoses

Humans: Weil’s Disease, Swine Herder’s Disease, etc.
- Flu-like symptoms (fever, headache, myalgia), +/- dermatitis, orchitis
- Severe forms – Pulmonary Hemorrhagic Syndrome,
  Hepatic/renal failure, most cases in NA are in Hawaii
At risk populations – abattoirs, dairy & swine farmers, water sports

Pathogenesis & Virulence Factors

- Can infect wide spectrum of animals
- Urine &/or contaminated water
  - Mm/skin → Leptospiremia → multiple organs (liver) → proliferation/host response (vasculitis/hepatitis) → renal convoluted tubules – dissemination (urine) → direct/indirect to new host

Virulence Factors
- Environmental survival
- Invade intact skin, m.m
- Motility (2 endoflagella)
- BioFilm
- Hemolysin
- LPS (binds host TLR2)
  - immunologically benign/tolerated → maintenance hosts
  - Not incidental hosts
- Cytotoxins
Leptospirosis Diagnostics

Options and Issues

Direct/Rapid Methods
- Darkfield/Fab Microscopy
  - Blood (early): Urine (later)
  - PCR

Culture
- EMJH Media
  - 30 °C

Sera (Acute & Convalescent)
- Live "known" serovars
  - Fetal heartblood, pericardial fluids

Gold Standard Microscopic Agglutination Test (MAT)

Serology (Ab) is Most Frequent Choice

Quick, inexpensive...
- Lab-to-lab variation, risky, cross-reactivity (vaccine serovars)

High specificity
- Retrospective
  - Public health, epidemiological value

Leptospirosis

One last thing – and then an example

- Maintenance Hosts & Incidental Hosts
  - Generally Maintenance Hosts are asymptomatic
  - Also shed pathogen in urine → environment
    - Occasionally – very young or highly virulent strain → clinical disease

- Incidental Hosts
  - Typically show clinical disease
    - immune status, serovar, strain virulence determine severity.
    - Generally shed very little

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Canine Leptospirosis

- Vets – consider Leptospirosis for any dog:
  - ... hepatic or renal failure, uveitis, pulmonary hemorrhage, acute febrile illness or abortion.
  - ACVIM (2010)

- Maintenance Host for
  - L. Canicola – typically asymptomatic; acute nephritis → pups

- Incidental Host for multiple serovars
  - L. Icterohaemorrhagiae (rats, raccoons)
    - Pulmonary Hemorrhage Syndrome – fever, DIC, rapid death
    - Acute Hepatitis & uveitis – fever, depression, anorexia, anemia, jaundice
    - Acute – subacute renal disease: oliguria, anuria, renal failure

Canine Leptospirosis

- Diagnosis
  - MAT
  - PCR (IDEXX Laboratories) – Canada?
  - Peak leptospiremia between 2-10 days, then urine
  - Culture – samples as per PCR
  - Post-mortem – Immunohistochemical/silver stain

- Prevention – in endemic areas
  - Avoid at-risk activities
    - Rats, raccoons
    - Stagnant, slow-moving water
    - ‘d rainfall, mid-to-late-fall
  - Vaccination annually – vaccines are effective
    - L. Canicola, L. Icteroh., Grippo., Pomona

- Treatment & Zoonoses (controlled contact)
  - Doxycline
Bovine & Porcine Leptospirosis

- **Bovine Maintenance serovars**
  - *L. borgpetersenii* Hardjo - abortion, ‘milk drop syndrome’ (agalactia)
  - *L. interrogans* Hardjo -

- **Bovine Incidental serovars**
  - *L. Icterohemorrhagiae* (rats) & *Grippotyphosa* (rodents)
    - Acute septicemia calves, lambs (abortions)
  - *L. Pomona* (swine)
    - Haemolytic septicemia – hemoglobinuria – renal failure

- **Intervention**
  - Vaccines, Abx

- **Porcine Maintenance serovars**
  - *L. Pomona* – septicemia in piglets
  - *L. Bratislava* – reproductive failure, abortions

- **Porcine Incidental serovars**
  - *L. Icterohemorrhagiae* (rats) & *Copenhageni* (rodents)
    - Acute septicemia young pigs,
    - Reproductive failure & abortions

- **Intervention**
  - Vaccines, Abx

Equine Leptospirosis

- **Clinical disease infrequent (renal rare)– despite serological evidence**

- **Maintenance Host serovar**
  - *L. Bratislava* – can cause reproductive failure, abortion

- **Incidental Host serovar**
  - *L. Kennewicki* (skunk); *L. Pomona* (swine) others
  - Acute – septicemia, fever, hepatitis, abortions
  - Chronic (2–3 weeks post infection)- Equine Recurrent Uveitis (Moon Blindness or periodic opthalmia)

- **Intervention**
  - skunk control/food water
  - Off-label bovine vaccines
    - don’t include *L. Kennewicki*
  - Quarantine, confirm (urine shedding)
  - Abx unrewarding

Epiphora, hypopyon, subluxated lens indicate glaucoma