SPIROCHAETES

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General characteristics

- They are spiral shaped bacteria
- Motile by flagella (two in number) present in periplasmic space
- Being present in periplasmic space, these flagella are called endoflagella
- Can be grown on special artificial media
- Cytochemically, they are gram negative
Classification

Order: Spirochaetales
Family: Leptospiraceae
Genus: Leptospira

Family: Spirochaetaceae
Genus: Borrelia
Subgenus: Brachyspira/Serpulina
Genus: Treponema
Leptospira

- Leptospires are motile helical bacteria (0.1 x 6 to 12 μm) with hook-shaped ends
- They do not stain well with common dyes
- Usually visualized using dark-field microscopy
- Silver impregnation and immunological staining techniques are used to demonstrate leptospires in tissues.
Leptospira

• Fragile organism
• Survive in ponds, rivers, surface waters etc.

• Formerly, two species were known:
  - *L. interrogans* (pathogenic), and
  - *L. biflexa* (saprophytes)

• Currently, seven species of leptospira is known
• More than 250 serovars in 23 serogroups

• Many of serovar are host adapted
## Maintenance and Accidental hosts

<table>
<thead>
<tr>
<th>Maintenance host</th>
<th>Accidental hosts</th>
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</thead>
<tbody>
<tr>
<td>• Maintenance hosts are highly susceptible</td>
<td>• Accidental hosts exhibit low susceptibility</td>
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<tr>
<td>• Disease is frequently mild or subclinical</td>
<td>• Disease is of serious nature</td>
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<td>• Prolonged excretion of leptospires in urine</td>
<td>• Poor transmission of leptospires to other animals</td>
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<td>• Severe form of disease is seen in young animals</td>
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<tr>
<td>Serovar</td>
<td>Maintenance hosts</td>
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<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>bratislava</td>
<td>Pigs, hedgehogs</td>
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<tr>
<td>canicola</td>
<td>Dogs</td>
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<tr>
<td>grippotyphosa</td>
<td>Rodents</td>
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<tr>
<td>hardjo</td>
<td>Cattle, (sheep occasionally)</td>
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<tr>
<td>icterohaemorrhagiae</td>
<td>Brown rat</td>
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<tr>
<td>pomona</td>
<td>Pigs, cattle</td>
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</table>
Pathogenesis

- Invade tissues through moist, softened skin or through mucous membranes, conjunctiva
- Motility may aid tissue invasion
- Haematogenous spread is observed
- Upon appearance of antibodies after 10 days, they are cleared from circulation
- Remain present in Renal tubules, uterus, eye or meninges
Acute leptopirosis

- In susceptible animals,
  - damage to red cell membranes
  - endothelial cells
  - hepatocellular injury
  - haemolytic anaemia,
  - jaundice
  - haemoglobinuria and haemorrhage
Leptospirosis in cattle and sheep

• Cattle are maintenance hosts for
  - *L. borgpetersenii* serovar hardjo and
  - *L. interrogans* serovar hardjo

• Susceptible heifers, infected for the first time at calving, may develop *acute disease with pyrexia and agalactia*.

• Infection may also result in *abortions and stillbirths*.

• Infection with serovar hardjo in sheep can cause *abortions and agalactia*. 
Infection in cattle and sheep

- Infection with serovars *pomona*, *grippotyphosa*, and *icterohaemorrhagiae* can cause serious disease, (particularly in calves and lambs).

- Infection is usually accompanied by *pyrexia*, *haemoglobinuria*, *jaundice* and *anorexia*.

- Extensive *renal damage with resultant uraemia* often precedes death.

- Serovar *pomona* which is an important cause of *bovine abortion* in some countries.
Infection in horse

• Serovar bratislava: abortions and stillbirths in horses

• **Serovar pomona** - abortion in mares and renal disease in young horses

• chronic leptospirosis- anterior uveitis (periodic ophthalmia, 'moon blindness')

• Cross-reactions between leptospiral antigens and proteins from the cornea and lens
Infection in Pig

- Usually affected with rodent adapted serovars - icterohaemorrhagiae and copenhagenii
- These serovars cause serious, sometimes fatal, disease in young pigs
- The principal host-adapted serovar is pomona
- Reproductive failure including abortions and stillbirths is seen
Infection in Dog

- Important serovars associated with leptospirosis in dogs are canicola and icterohaemorrhagiae.
- Serovars grippotyphosa and pomona emerging as important canine pathogens
- *Serovar canicola*, which is host-adapted for dogs, *causes severe renal disease in pups*
- In surviving dogs, *a chronic uraemic syndrome* may develop
- Infections caused by icterohaemorrhagiae are characterized by *acute haemorrhagic disease or subacute hepatic and renal failure*
Leptospirosis in dog

- The severity is variable, depending on several factors, including
  - age and immune reaction of the host, and
  - the virulence of the infecting serovar

- The incubation period is approximately five to 15 days
Leptospirosis in dog

- Peracute, acute and subacute/chronic manifestations of the disease are observed
- In peracute cases, sudden death is seen
- Acute cases – ch(by pyrexia, shivering, by pyrexia, shivering, muscle weakness, vomiting, dehydration and shock, and tachypnoea
- Hepatic and renal failure do not have time to develop.
Leptospirosis in dog

• Subacute leptospirosis is characterised by
  - Fever, Anorexia, Vomiting,
  - Dehydration and increased thirst
  - Lethargy, abdominal pain,
  - Muscle pains and/or diarrhoea
  - Causing hepatic encephalopathy, and icterus

• Coughing and dyspnoea may also occur

• Some dogs develop conjunctivitis, rhinitis and tonsillitis

• Polyuria and polydipsia can develop - deterioration of renal function and/or liver insufficiency.
Diagnosis

- Clinical signs and symptoms
- History exposure to contaminated urine
- Visualised in fresh urine by dark-field microscopy
- Fluorescent antibody procedures (FAT) are often used for the demonstration of leptospires in tissues. Suitable tissues include kidney, liver and lung
- Silver impregnation techniques can also be used for demonstration of leptospires
- PCR
Microscopic agglutination test (MAT)

- The standard serological reference test, is microscopic agglutination test (MAT)
- It involves mixing live culture growing with equal volumes of doubling dilutions of test serum.
- Titres in excess of 1:400 or a four-fold rise in the titre in paired
- The MAT is a serogroup-specific assay and cannot be relied upon to detect the infecting serovar
- The MAT is read by dark field microscopy -Both IgM and IgG antibodies
- Titers following acute infection may be extremely high (≥25,600)
- A number of ELISA tests have been developed
Isolation of leptospira

- Leptospires may be isolated from:
  - Blood - first seven to ten days of infection
  - Urine - two weeks after initial infection
- In liquid medium or by animal inoculation
- Slow-growing serovars such as hardjo may require incubation for six months in liquid media at 30°C
- *EMJH (Ellinghausen, McCullough, Johnson and Harris)* medium based on 1% bovine serum albumin and Tween 80
Human Leptospirosis

- Occupational hazard and Human is regarded as Accidental host
- Veterinarians, Abattoir workers, Livestock Farmers, Paddy field workers, persons involved in sewage / drainage cleaning
- It’s a potentially fatal zoonosis
- Mainly endemic in tropical areas with heavy rainfall and flooding
- Portals of entry include cuts and abrasions or mucous membranes such as the conjunctival, oral, or genital surfaces
- Infection is mostly acquired through water contaminated with infected Urine
- Brown rat is important source of human infections.
Human Leptospirosis

- *Acute febrile illness characterized by sudden onset of fever, myalgia, vomiting, jaundice and headache*
- Conjunctival suffusion (dilatation of conjunctival vessels without purulent exudate)
- Subconjunctival hemorrhages and icterus
- Hepato-cellular damage, Renal dysfunction
- Multisystem organ failure
- *Severe pulmonary hemorrhage syndrome* (SPHS) due to extensive alveolar hemorrhage has a fatality rate of >50%.
- Fatality is more in patients with age 60 or more.
Human Leptospirosis

- The combination of jaundice and renal failure, known as **Weil’s disease**,
- **Weil's disease** is a severe form of leptospirosis.
- **doxycycline** or penicillin, should be given early in the course of the disease
- Pre-exposure - doxycycline (200 mg orally once per week)
- Post exposure - doxycycline 100 mg orally twice per day
- Intravenous antibiotics may be required for persons with more severe symptoms.