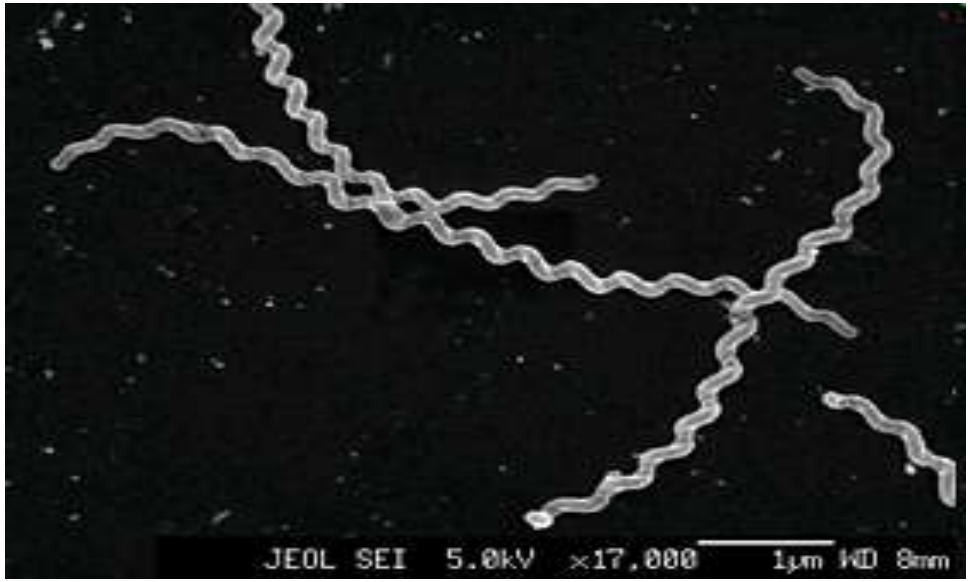
leptospirosis

Leptospira

It was described by Adolf Weil in 1886



Synonyms- Weil's disease

- Mud / Swamp fever
- Japanese 7 day fever
- Rice Field Fever
- Spirochete Jaundice
- Canicola Fever
- Leptospiral Jaundice
- Autumn Fever
- Swineherd's Disease

Leptospirosis

Infectious disease that is caused by pathogenic spirochetes of the genus *Leptospira.* It is considered economically important and the most common zoonosis in the world characterized by causing:

abortions, stillbirths, infertility, and loss of milk production, mortality in calves, and decreased daily gains in dairy and also in beef production.

Leptospirosis has recently been recognized as a re-emerging infectious disease among animals and humans.

ETIOLOGY

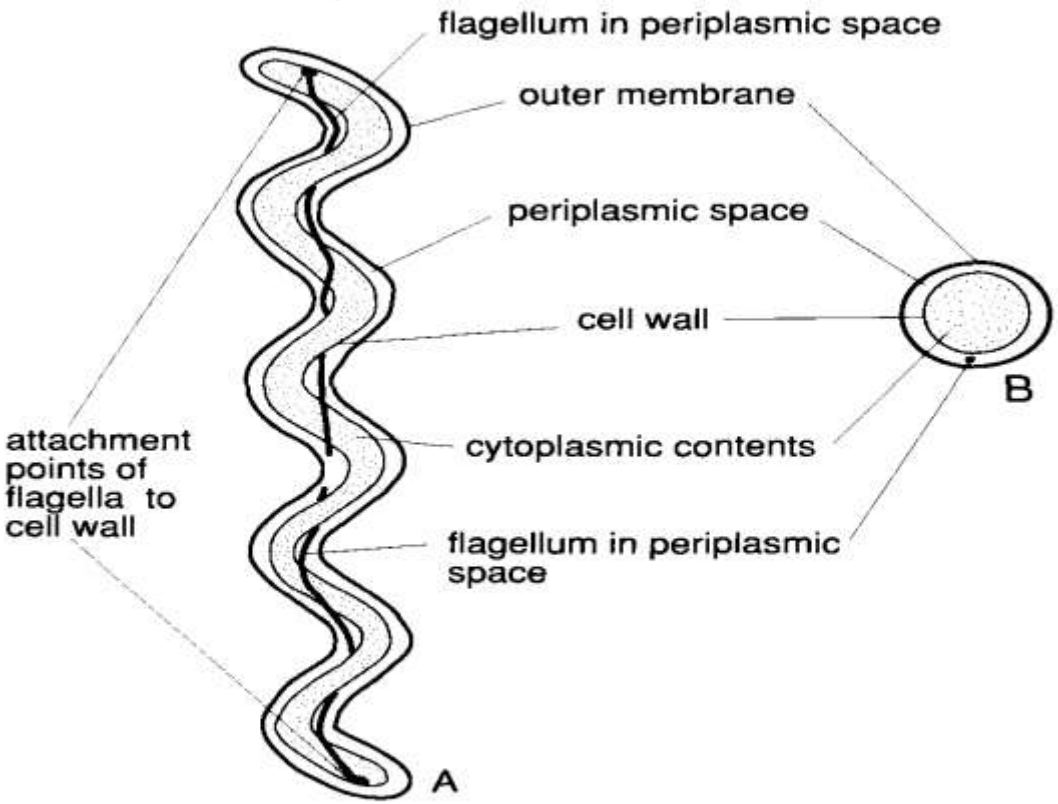
Causative organisms : Leptospires

- Order : Spirochaetales
- Family : Leptospiraceae
- Genus : Leptospira
- Pathogenic species*: Leptospira interrogans.*

L. borgpetersenii

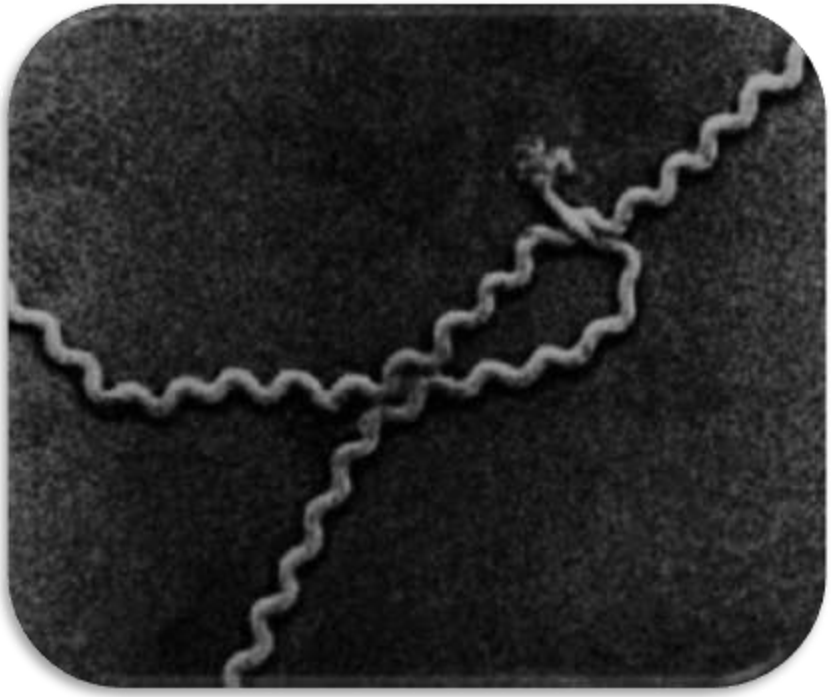
- Non pathogenic *: Leptospira biflexa* (saprophytic)
- Leptospira interrogans has over 20 serogroups & > 200 serotypes.

Structural features of a typical spirochaete (A) and their relationships in cross section (B).



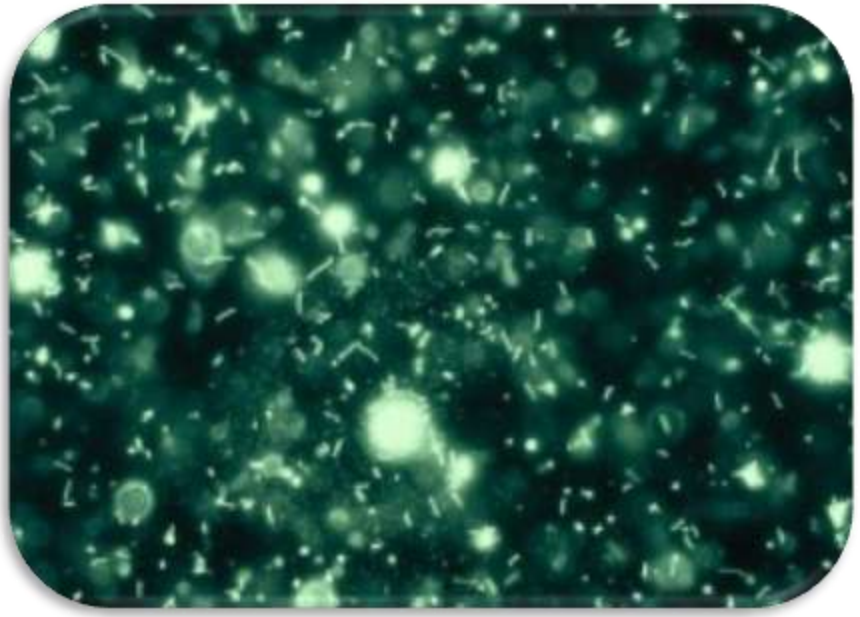
Spiral or helical bacteria with endoflagella
Although Gram-negative, many stain poorly by conventional methods

Leptospira under the Microscope

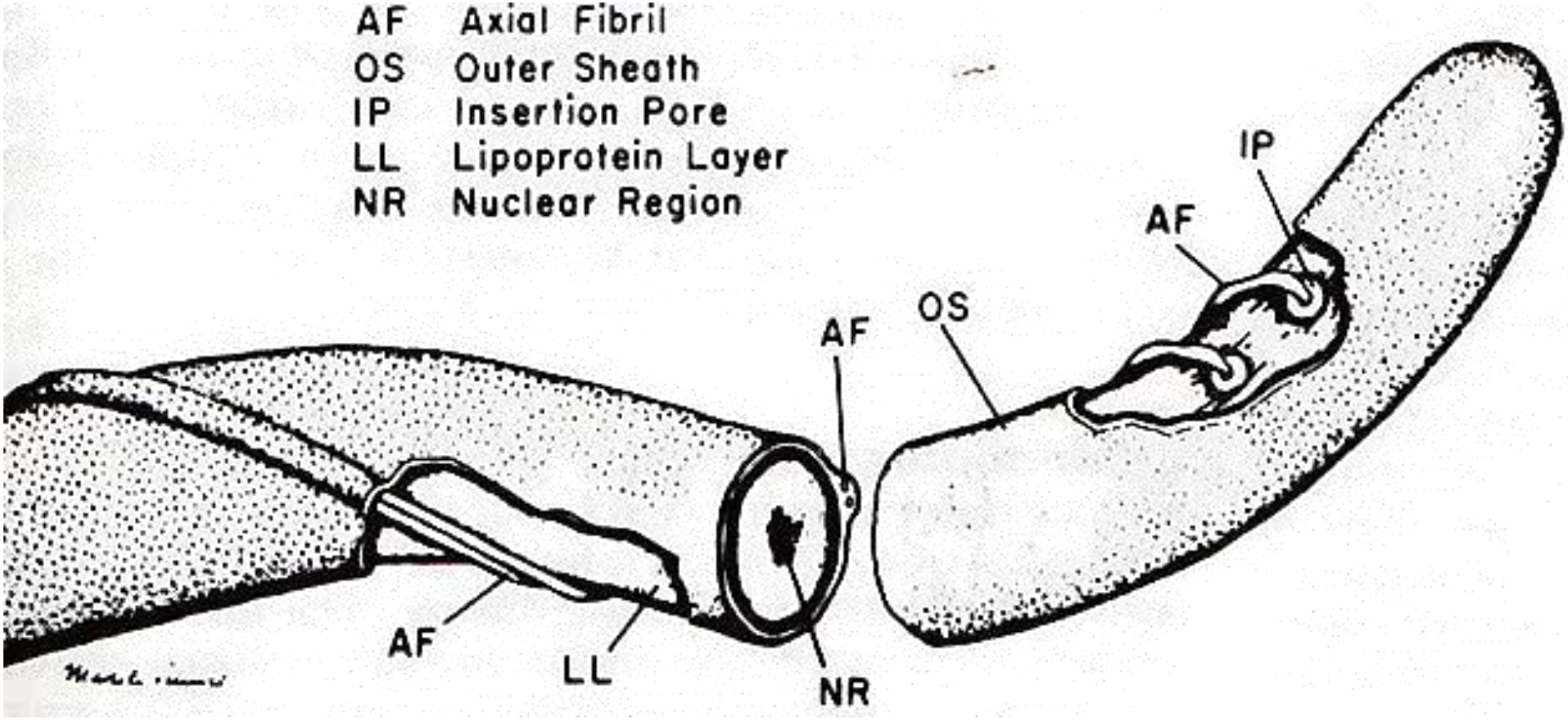


Long, Thin, flexible, Highly Coiled

Dark Field Microscopy FL



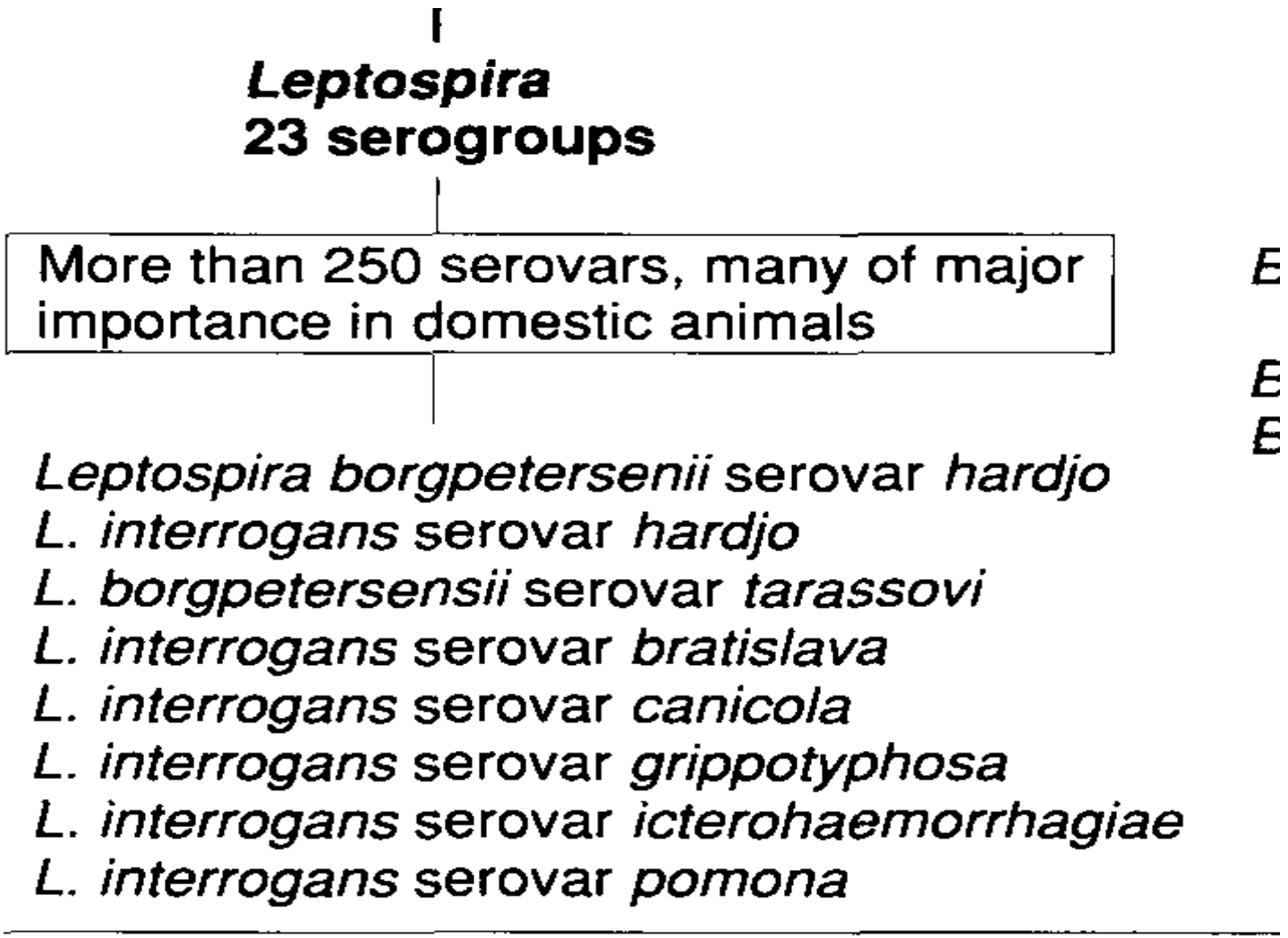
Periplasmic Flagella Diagram



Animals affected

- Rodents, swine, cattle, horses, goats, dogs and man.

New classification according to DNA studies



Virulent factors: The mode of causing disease is not so clear for this bacteria but mostly it involves many suggested mechanisms.

- Pathogenic **Leptospira** present **several surface proteins that mediate the interactions between the bacteria with the extracellular matrix and host cells.**

- Proteins that facilitate adhesion and invasion of host cell are **collagenase, hemolysins, phospholipids Hyaluronidases, Phospholipases glycoproteinases and sphingomyelinases.**
- ***Leptospira interrogans*** has been considered as an agent inductor of **apoptosis of macrophages and hepatocytes.**

- The spiral movement facilitate adherence to renal tubular epithelial cells by lipoproteins wall and LPS.
- **Complicated immune response** that harms the host through the production of many cytokines.

PATHOGENESIS

Leptospires → enter into the body of a → susceptible host through mucous membrane or abraded skin → After 4 to 10 days---- bacteraemia(lasting from hours to 7 days)--- and may be characterised by pyrexia, leptospires in the milk and anorexia----- --------- localization &colonization in tissues- liver, kidneys, lungs, genital tract, CNS--------- production of unidentified toxin (s).-------symptoms appear----------

- damage to vascular endothelium particularly small ones--------localized ischaemia---------- renal tubular, hepatocellular and pulmonary damage- myositis-and placentitis..... Capillary damage during the septicaemic phase, petechial haemorrhages in mucosae.... Activation of coagulation cascade (human) ----DIC..... Any organ can be affected in acute Leptospirosis-----haemorrhages----multiorgan failure and jaundice in severe cases.

agglutinating antibodies appear----
clearance of leptospires from blood and most organs -----clinical signs resolve- damaged organs take some time to return to normal function....

- Immunity appears to be solely humoural with circulating antibodies opsonising leptospires, causing cessation of bacteraemia.

* With the appearance of circulating antibodies, leptospires localise and persist in a number of organs, especially in the proximal renal tubules and in the female genital tract.

The duration of such localisation, and urinary shedding will depend on host-serovar adaptation. When leptospires are infecting a definite host, infection of these organs will be long-term, perhaps even for life.

However, **pathogenesis and clinical symptoms** will depend on the:

- Susceptibility of the host.
- serotype of leptospira.
- virulence of the organisms.

- The following features for diagnosis of acute leptospirosis;
- a) sudden onset of agalactiae in adult cattle,
- b) icterus in young animals; and
- c) meningitis.

1. Leptospira spp in dark field microscopy

- In the case of *L. pomona* infection intravascular haemolysis and interstitial nephritis are important parts of the disease, whereas *L. hardjo* produces no haemolysin and cause no interstitial nephritis

Mode of transmission: Transmitted mainly via infected urine.

Infection may occur via

a. direct contact with urine, placental fluids or milk of infected animals or

b. indirect contact with contaminated water / soil/ vegetations following rains.

Modes of Transmission

Leptospira can enter through

1. **Broken skin with infected soil, water or vegetation**
3. **Ingestion of contaminated food & water**
4. **Inhalation of droplets of infected urine.**
5. Venereally or transplacentally (vertically).

- **Two types of hosts:**
- Maintenance host(s), which serve as reservoirs of infection. Maintenance hosts are often wildlife species and, sometimes, domestic animals and livestock. Transmission of the infection among maintenance hosts is efficient and the incidence of infection is relatively high.
- Incidental hosts (عرضي.ثانوي.تصادفي) are not important reservoirs of infection and the incidence of transmission is low. Transmission of the infection from one incidental host to another is relatively uncommon.

In maintenance hosts, leptospirosis is generally characterized by a;

low serologic response,

relatively mild acute clinical signs,

and a prolonged renal carrier state, which may be associated with chronic renal disease.

In incidental hosts, leptospirosis

- can cause severe disease,
- is associated with high titers of agglutinating antibody,
- has a short or negligible renal carrier state.
- The clinical signs observed vary with the susceptibility of the host and with the infecting serovar.
- In general, young animals are more seriously affected than adult animals.

Reservoirs: Living reservoirs are wild animals including rodents, pigs, cows, pets like dogs and horses. There are also environmental reservoirs, such as soil and surface water contaminated by the urine of these animals, which is how the disease is transferred

Clinical signs

Symptom of leptospirosis in cattle:

A. In apparent or subclinical form: Many infected animals do not show signs of clinical disease.

B. Clinical form;

Leptospirosis in cattle may appear **as acute, subacute or chronic forms.** In all animals the incubation period is from 3 to 7 days

A. Acute leptospirosis

- Acute leptospirosis in cattle is characterised by one or more symptoms of: Fever, haemolytic anaemia, haemoglobinuria(red water), hepatitis, jaundice, interstitial nephritis, meningitis, and agalactiae(milk drop).
- **the following features for diagnosis of acute leptospirosis; a) sudden onset of agalactia in adult cattle, b) icterus in young animals; and c) meningitis.**

- With *Leptospira pomona* infection the haemolytic and mastitic form may appear together and redwater occasionally accompanies this unusual mastitis condition, and may produce severe sickness.

Leptospira hardjo infection is caused by ;

- *L. borgpetersenii servar. hardjo*
- *L. interogans servar. hardjo*

In *L. hardjo* infection

- there is a sudden onset of fever, anorexia, immobility and agalactia.
- The milk is yellow to orange and may contain clots. The udder is flabby, has no heat or pain, and all four quarters are equally affected. This may affect up to 50% of cows at one time, causing a precipitate fall in the herd's milk yield.
- Abortion may occur several weeks later, but may also occur as the only evidence of the disease.
- *L. hardjo*, is a principal cause of abortion in cattle. many cows in a herd show subclinical infections with *L. hardjo* in which only a fall in milk yield may be detectable .

- Cows may abort in late pregnancy due to either *Leptospira pomona* or *Leptospira hardjo.* Abortion may occur without, or some weeks after, other symptoms of leptospirosis.

Leptospirosis can cause milk drop affecting a large proportion of the herd.

Leptospirosis is a common cause of abortion in dairy and beef herds

Infection may cause an increased number of repeat breeder cows

B. Subacute leptospirosis

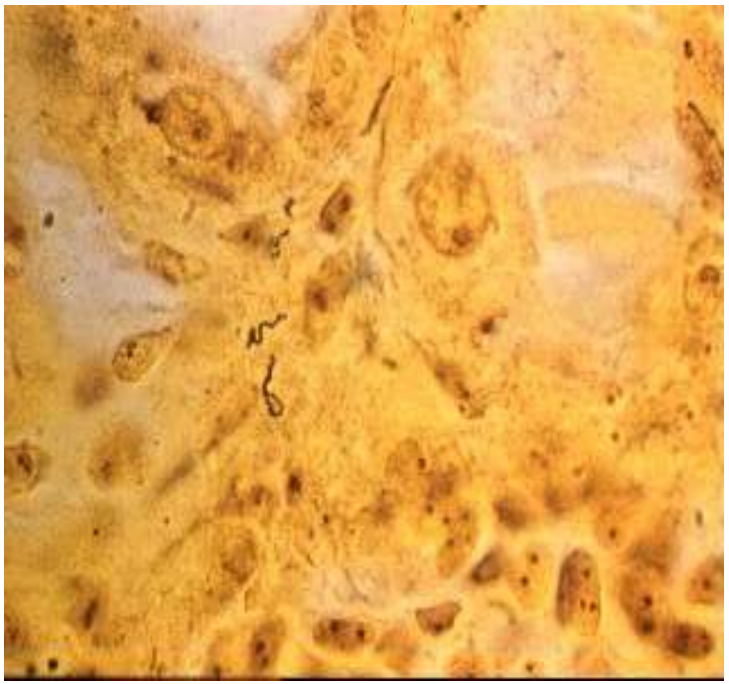
- This form of the disease differs from the acute form only in degree, approximately the same signs being observed in a number of affected animals but not all of the signs necessarily being present in the one animal.

C. Chronic leptospirosis;

- Reproductive loss through abortion, stillbirth, or birth of premature and weak infected calves. Infected but healthy calves also may be born.
- Persistent serovar hardjo colonization of the uterus and oviducts may be associated with (**INFERTILITY**) characterized by increased services per conception and prolonged calving intervals.

Animals which have recovered from acute leptospirosis may develop a;

- **Carrier condition** in which leptospires grow and remain in the renal tubes for periods of days to years. These **excretory animals** are the central points of distribution of leptospires to other animals or people.



However, *L. hardjo* can also persist in other organs, notably the genital tract of cattle.

Leptospirosis is rare in sheep and goats,

- Redwater resulting from infection with *Leptospira pomona* can occur.
- In most cases animals develop acute septicemia and are found dead.
- In *Leptospira hardjo* infections, abortion may be the only sign,
- Milk drop syndrome similar to one observed in cattle can be seen in lactating ewes.

Horses: Horses may be infected with *Leptospira pomona*, leading to severe sickness, redwater in foals, and abortion. There may also be a connection between *Leptospira pomona* infection and a persistent eye condition called periodic ophthalmia or moon blindness.

There is strong presumptive evidence that the chronic form of leptospirosis in horses causes periodic ophthalmia

Periodic ophthalmia, otherwise known as recurrent uveitis, uveitis, or moon blindness, can be a devastating disease of the equine eye. It also, unfortunately, is a disease that we really don't know much about

Classic appearance of long-standing uveitis. Note the scarring of the iris and the white reflective cataract.

Infection in dogs

Signs and Symptoms of Leptospirosis in dogs

The severity of symptoms varies, and depends on the dog (age, immune response, vaccination status), the strain of *Leptospira*, and other factors. Some dogs may have mild symptoms or no symptoms at all, but severe cases can be fatal. Signs and symptoms may include:

- fever
- joint or muscle pain - this may manifest as a reluctance to move
-

- decreased appetite
- weakness
- vomiting and diarrhea
- discharge from nose and eyes
- frequent urination - may be followed by lack of urination
- yellowing of the gums, membranes around the eyes, and skin (jaundice)

Icteric dog with acute leptospirosis infection

Icteric condition of the mucousmembrane

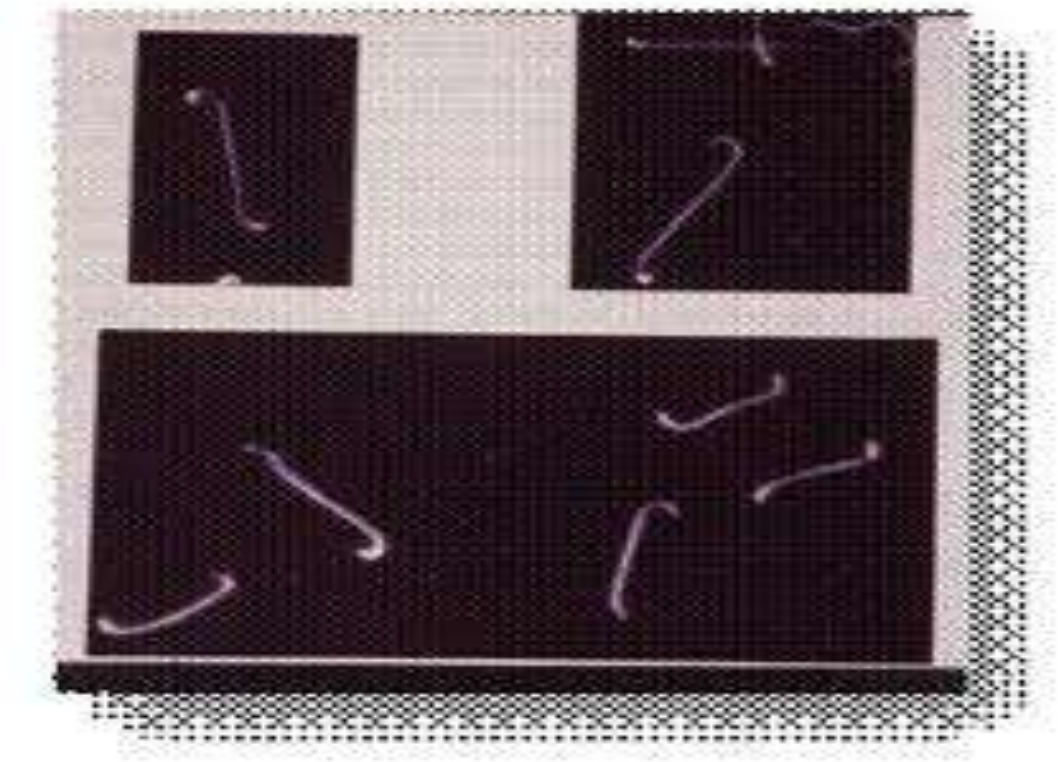
Icteric of the foot pad

Liver after postmortem appears as icteric mottled

diagnosis

- 1.History and clinical signs may indicate leptospirosis, diagnosis however needs to be confirmed by laboratory tests.

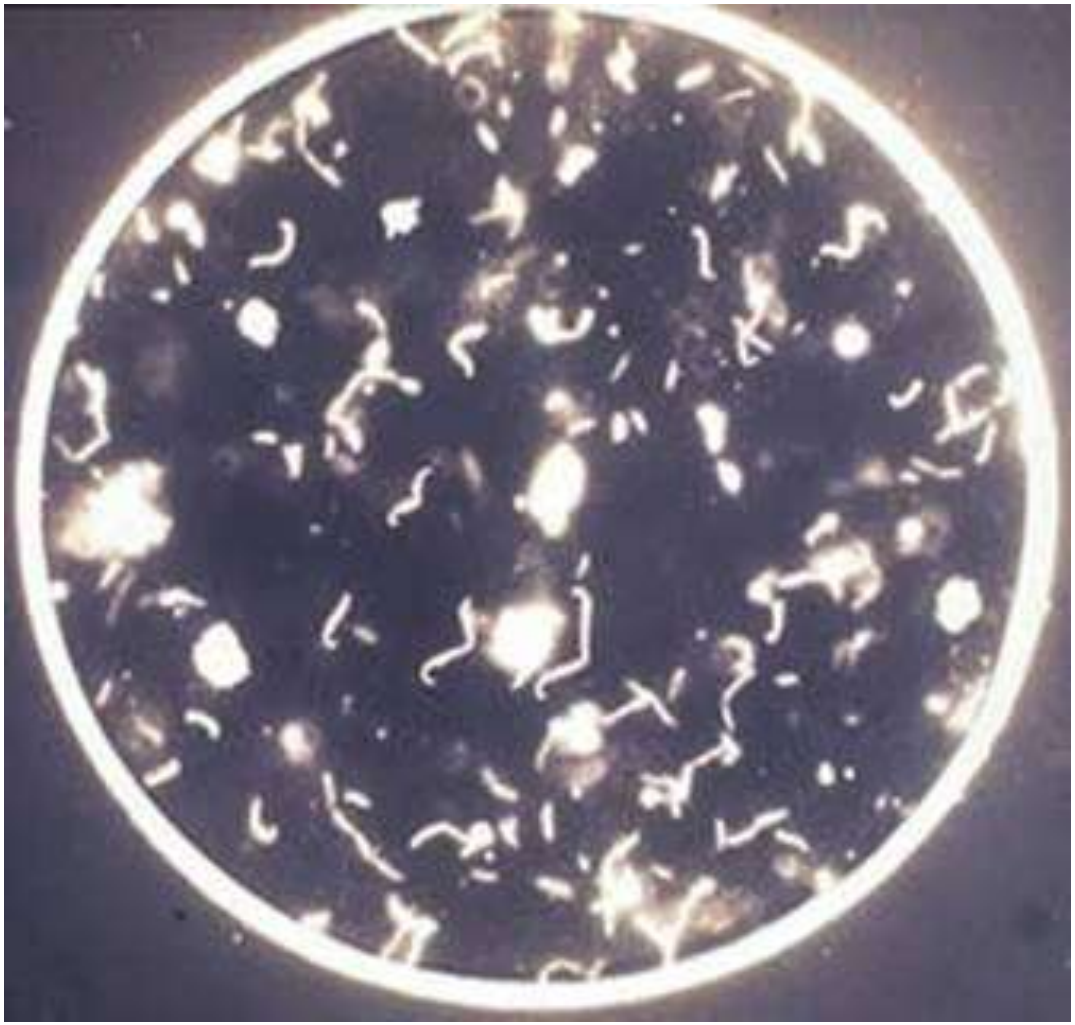
2.Direct detection of the bacteria in urine and blood of acutely affected animals using the dark field illumination tecnique



- This is an illumination technique used to enhance the contrast in unstained samples. This test provides direct visualisation of spirochetes from blood or urine specimens, or visualisation of agglutination in the microscopic agglutination test (MAT).
- The advantage of darkfield microscopy is speed; disadvantages include low specificity and sensitivity.

Darkfield microscope photo

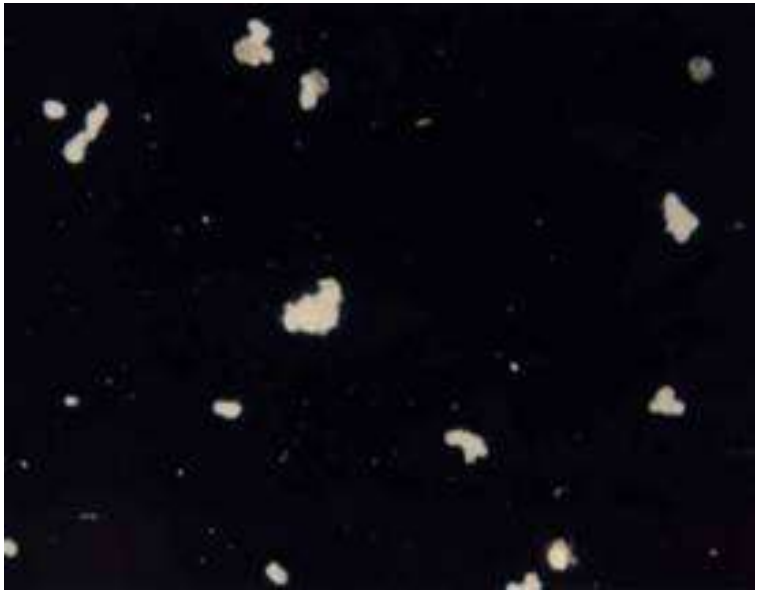
Leptospires are observed as thin, highly coiled, rapidly moving in fluids with bi-hooked ends



3.Serology

a. The microscopic agglutination test (MAT)

- The standard laboratory diagnosis of bovine leptospirosis
- MAT is unable to differentiate between natural infection and vaccine induced titres



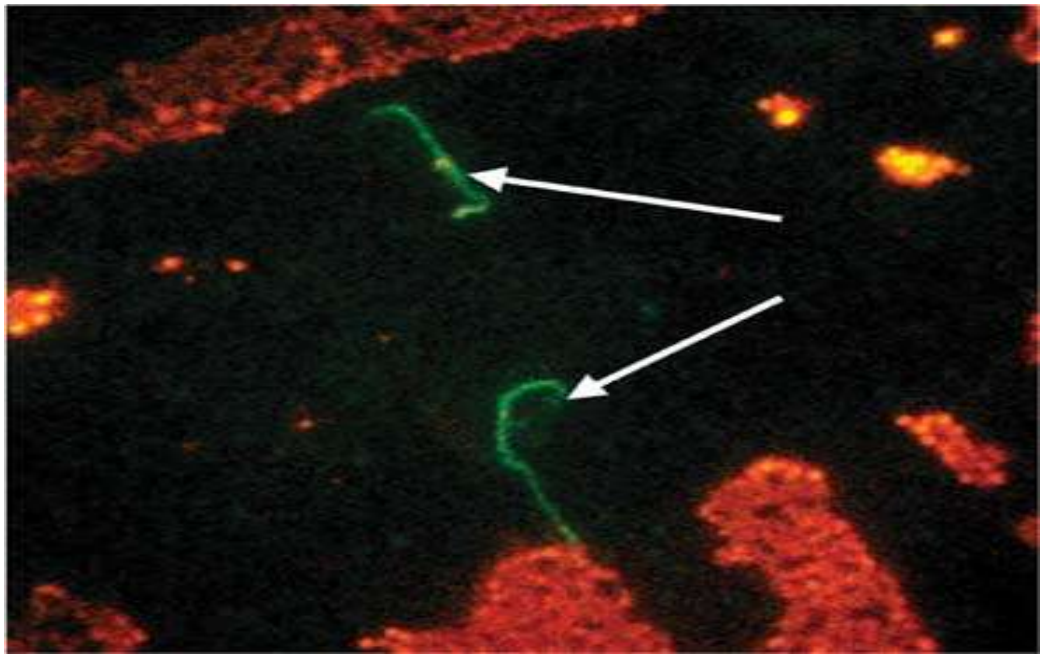
- Live antigens of leptospires react with serum samples and then they are examined for agglutination using darkfield microscopy.
- This method will provide delayed confirmation because it involves pairing of acute and convalescent sera collected 2 weeks apart.
- A serologically confirmed case of leptospirosis involves a fourfold increase in MIT titre to 1 or more serovars between acute and convalescent phases.

- b. Macroscopic slide agglutination test(MSAT) This test, which uses killed antigen, is useful for screening but is not specific.

It is done using dense suspension of killed leptospires which is mixed with a drop of serum on a slide and rotated on a rotator (120rpm) for 4 minutes. It was then examined by naked eye for presence of agglutination. All cases were confirmed by MAT.

- C .ELISA: Herd screening tests. A bulk milk and srum ELISA test is available.Pooling milk samples from first lactation heifers is a useful way of monitoring the infections in a herd. Serum can also be used to detect antibodies for leptospirosis

d. Immunofluorescence can be used to identify leptospires in tissues, blood, or urine sediment by using a stained conjugated positive serum for leptospira. The availability of this test is increasing, and the test is rapid, has good sensitivity, and can be used on frozen samples.



Diagnosis

4. Culture: from urine , milk or blood.

- Leptospiral isolation is costly, very difficult, and often unsuccessful; although it is the definitive method for the diagnosis of leptospirosis. .

5. Molecular techniques such as PCR have the potential to improve leptospirosis diagnosis.

6. **Urinalysis:** shows mild proteinuria, pyuria, haematuria, haemoglobinuria and hyaline or granular casts

Treating Leptospirosis

1. Antibiotics are used to kill *Leptospira* bacteria.

- given in two stages: one type of antibiotic to treat the initial infection, followed up with a different kind of antibiotic to avoid or prevent the shedding of bacteria in the urine. The earlier treatment is started, the better.
- Animals with acute leptospirosis can be treated with tetracycline (10 to 15 mg/kg twice daily for three to five days).
- Injectable, long-acting oxytetracycline or amoxicillin have been shown to be effective in eliminating shedding in cattle infected with serovar Hardjo.

- In dogs, penicillin is most commonly used to end the leptospiremic phase (infection of the blood), and doxycycline is used to eliminate the carrier state.

Controle:It is based on prevention of exposure, vaccination, and selective treatment.

- Rodent control measures reduce the chances of infection, and in areas where Leptospirosis is common, preventing dogs from swimming in ponds and slow-moving water can also help.

- Although the vaccines are not 100 percent effective and do not protect against all types of *Leptospira*, vaccination is still recommended to help prevent a potentially serious disease that can be transmitted to people.
- Polyvalent vaccines containing common serovars endemic to the host and region are generally available.

- Different vaccines vary in efficacy and vaccine failures may occur.
- In general, annual vaccination of all cattle in a closed herd or low incidence area with appropriate bacterins,
- or twice-yearly vaccination in an open herd or high incidence area, is the most effective approach to control.

Differential diagnosis:

1. Diseases characterized by haemoglobinuria and hyperbilirubinaemia like babesiosis, bacillary haemoglobinuria, onion poisoning and other causes of hemolytic anaemia.
2. Diseases causing abortion, stillbirth and infertility in cattle and horses.