

L 11 :- Spirochetes,  
*Mycobacterium tuberculosis*,  
*Mycobacterium leprae*,  
Actinomyces,  
Chlamydiae  
by

prof. Dr. Nada Khazal

# Spirochetes

Spirochetes are long, slender, motile, flexible, undulating, gram-negative bacilli that have a characteristic helical shape. Depending on the species, they can be facultative anaerobic. Some spp can be grown in laboratory culture (either cell-free culture or tissue culture), whereas others cannot. Some spp are free-living, and some are part of the normal flora of humans & animals. Thy are important human pathogens are :

1. *T. pallidum* (**syphilis**),
2. *Borrelia* (causes **Lyme disease, & relapsing fever**)
3. *Leptospira* (causes **leptospirosis**)

# *Treponema Pallidum*

Syphilis is a **sexually transmitted disease (STD)** caused by *T. pallidum*. Starting with a small lesion (**chancre**), several progressive stages of the disease can span a period of 30 years or more. The causative organism of syphilis is extremely fastidious and fragile. It cannot be cultured routinely in the laboratory, and is sensitive to disinfectants, heat, and drying. *T. pallidum* is so thin that it cannot be observed by light microscopy, but requires immunofluorescent or dark-field techniques. It produces **hyaluronidase** that disrupts ground substance, and facilitates dissemination of the organism.



## Pathogenesis & Clinical significance

**Transmission** of *T. pallidum* is almost always by sexual contact or transplacentally (congenital syphilis). The organism enters the body through a break in the skin, or by penetrating mucous membranes, such as those of the genitalia.

**Syphilis:** Syphilis occurs in three stages. The first symptom of primary stage syphilis is a **hard genital or oral ulcer (chancre)** that develops at the site of inoculation. The **secondary stage** may be accompanied by **systemic involvement, causing hepatitis, meningitis, nephritis**. In 40% of infected individuals, the disease progresses to a **tertiary stage**, characterized by **degeneration of the nervous system, cardiovascular lesions** such as **gummas lesions in the liver, skin, and bones**.

**Congenital syphilis:** It can be transmitted through the placenta to a fetus after the first 10 to 15 weeks of pregnancy.

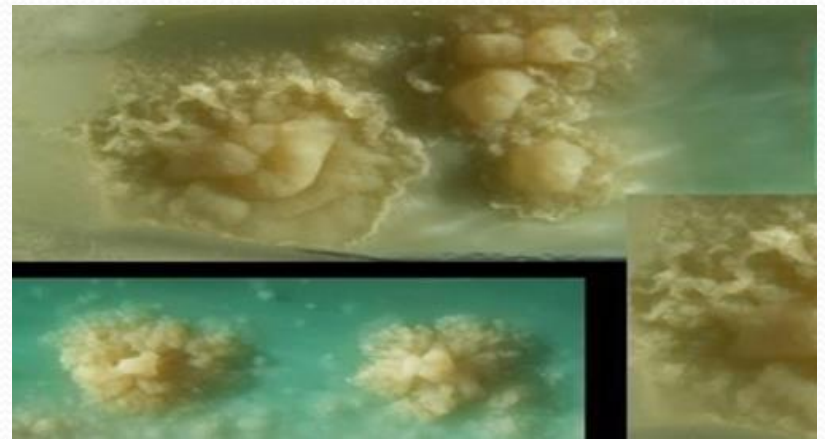
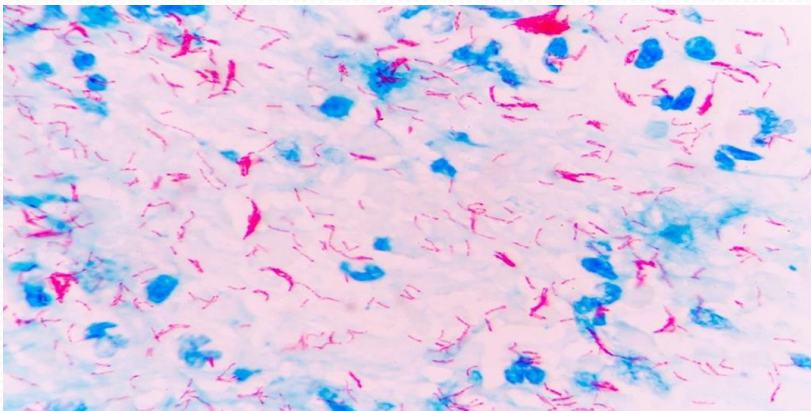
**Laboratory identification:** can be detected microscopically using immunofluorescent stain or dark-field illumination, syphilis is usually diagnosed serologically.

**Treatment and prevention:** penicillin is effective for primary and secondary syphilis. There is no vaccine against *T. pallidum*; **prevention** depends on safe sexual practices.

# *Mycobacterium tuberculosis* or tubercle bacillus (TB)

**TB** is long, slender rods, strictly aerobic that are nonmotile and has not form spores. TB have thick cell walls, they are 60% lipid, (**mycolic acids**), therefore resistant to drying, but not to heat or ultraviolet irradiation.

**The identification:** A microscopic by using the Ziehl-Neelsen stain (acid-fast bacilli) is the most rapid test for mycobacteria. Culture: Lowenstein-Jensen medium.

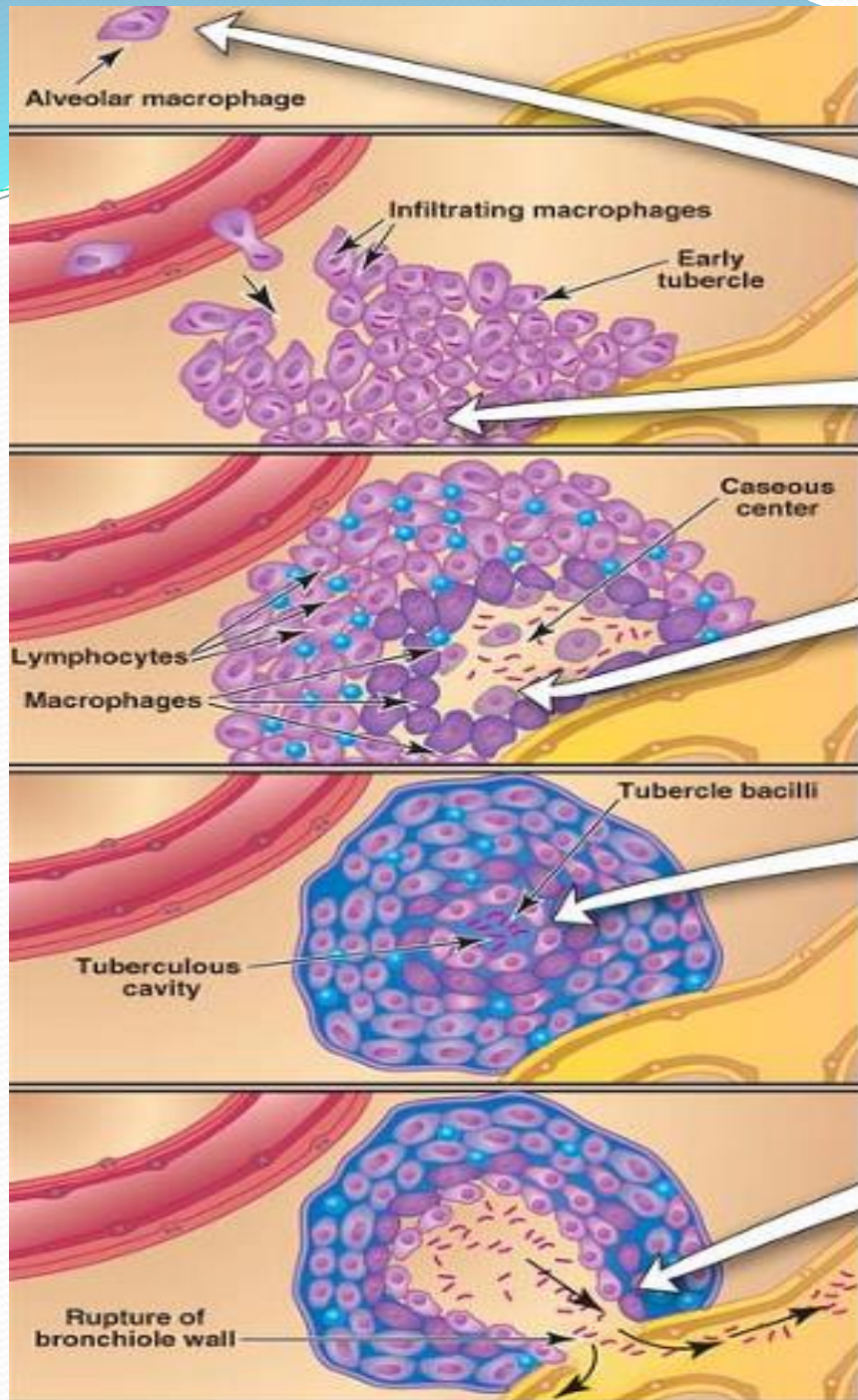




## Pathogenicity & Clinical significance of TB: as shown in following figure.

Mycobacteria are emitted in droplets when infected persons cough, sneeze, or speak. The droplets evaporate, leaving organisms that are small enough, when inhaled, to be deposited in alveoli the host's immune system responds by release of cytokines and lymphokines that stimulate monocytes and macrophages. Mycobacteria begin to multiply within macrophages. Some of the macrophages develop an enhanced ability to kill the organism, but others may be killed by the bacilli. Pathogenic lesions associated with infection appear in the lung 1–2 months after exposure. Within 2 to 4 weeks, many bacilli are destroyed by the immune system, but some survive and are spread by the blood to extrapulmonary sites. The virulence of TB rests with its ability to survive and grow within host cell, however, when engulfed by macrophages, bacteria inhibit the fusion of phagocytic vesicles with lysosomes. Primary tuberculosis occurs in a person who has no previous contact with the organism. For the majority of cases (about 95 %), the infection becomes arrested. The only evidence of tuberculosis may be a positive tuberculin test. A chest radiograph sometimes shows the initial pulmonary nodule, and some fibrosis the classic **Ghon complex**.





**1** Tubercle bacilli are inhaled into the alveoli of the lung and ingested by macrophages, but are not killed.

**2** Tubercle bacilli multiplying in macrophages cause additional macrophages to migrate into the area, forming an early tubercle.

**3** After a few weeks, many of the macrophages die, releasing tubercle bacilli and forming a caseous center in the tubercle, which is surrounded by a mass of macrophages and lymphocytes. The disease may become dormant after this stage.

**4** In some individuals, a mature tubercle is formed, as a firm outer layer containing fibroblasts surrounds the mass of macrophages and lymphocytes. The caseous center enlarges by the process of liquefaction, forming a tuberculous cavity in which the bacilli multiply.

**5** Liquefaction continues until the tubercle ruptures, allowing bacilli to spill into the bronchiole and be disseminated throughout the respiratory system and other systems of the body.



**Immunity:** *M. tuberculosis* stimulates both a humoral and a cellular immune response.

**The identification:** Diagnosis of TB includes demonstration of clinical symptoms and abnormal chest radiographs, and confirmation by Identification of TB in clinical specimens: A microscopic search for acid-fast bacilli using the Ziehl-Neelsen stain is the most rapid test for mycobacteria. Culture: Lowenstein-Jensen medium.

**Tuberculin reaction:** In the routine procedure, a measured amount of PPD is injected intradermally in the forearm. It is read 48 to 72 hours later for the presence and size of an area of induration (hardening) at the site of injection, which must be observed for the test to be positive.

**Treatment:** Isoniazid, rifampin, ethambutol, streptomycin, and pyrazinamide

**Vaccines:** A vaccine is Bacille Calmette-Gurin (BCG), an attenuated strain of *M. bovis*. When injected intradermally, it can confer tuberculin hypersensitivity and an enhanced ability to activate macrophages that kill the pathogen.



# Mycobacterium leprae

*Mycobacterium leprae* is an obligate intra-cellular parasite in man, multiplying mainly in histiocytes and Schwann cells. The entry of the bacilli into the Schwann cells causes peripheral neuropathy. *M. leprae* is a bacterium that causes **leprosy**, also known as "Hansen's disease"

**Leprosy** is a chronic infectious disease caused by *Mycobacterium leprae*. It damages peripheral nerves and can affect the skin, eyes, nose and muscles. Nerve injury in leprosy can cause severe disabling deformities.

People who develop leprosy usually incubate the infection for 3–5 years before manifesting illness.

## Treatment of *M. leprae*

Current treatment of leprosy involves use of 3 drugs: rifampicin (rifampin); clofazimine; and **dapsone**.

The duration of therapy was recently reduced from 24 to 12 months.



# Actinomyces

They are gram-positive. Actinomyces are facultative anaerobic (except *A. meyeri* and *A. israelii* both obligate anaerobe), and they grow best under anaerobic conditions. **Actinomyces is a genus of the bacteria form long filaments in the soil. The Actinomycetes exhibit characteristics intermediate between bacteria and fungi.** It work together to control harmful or unwanted soil bacteria.

**Actinomycetes produces antibiotics, such as Streptomycine, Erythromycin, Neomycin, and Tetracycline**

## Disease is caused by Actinomyces

The *Actinomyces* inhabits as part of the normal oral flora.

*Actinomyces* live in certain mucous membranes, like throat, intestinal tract (gut) and female genital tract. **The main symptoms:** fever, Weight loss, lesion fluid-filled areas on neck, jaw or face or in mouth, severe jaw tightness, lung infection.

Abdominal pain, Vaginal bleeding, pelvic infection, and cervical infection

**The complications are** necrosis, osteomyelitis and Brain abscess. Organ failure.

**Mode of transmission:** *It is* transmitted via direct contact between individuals

**The treatment of Actinomyces:** High doses of penicillin or tetracycline are usually necessary to cure the infection.



## **Obligate intracellular bacteria include: Chlamydiae and Rickettsiae:**

These organisms are obligate intracellular parasites of eukaryotic cells like people, animals and birds. They are small Gram-negative rod shaped to coccoid.

**Chlamydiae exhibit characteristics intermediate between bacteria and viruses.** It attached to the squamous epithelial cells and macrophages of the respiratory and gastrointestinal tract.

**They are recognized as bacteria as**

1. They have both DNA and RNA.
2. They have cell wall and ribosomes
3. Replicate by binary fission
4. Susceptible to antibiotics

**Diseases produced by chlamydia**

**Ocular infections:** C. trachomatis serotype A,B,Ba,C- is the leading cause of blindness (the chlamydia infection called trachoma ). Other diseases produced are inclusion conjunctivitis (serotype D to K) and ophthalmia neonatorum.

**Genital infections:** C. trachomatis is also the leading cause of sexually transmitted disease worldwide. It is associated with non- gonococcal urethritis and lymphogranuloma venereum (serotype L<sub>1</sub>, L<sub>2</sub>, L<sub>3</sub>). C. trachomatis is one of the major causes of pelvic inflammatory disease **PID** and infertility in women.

**Respiratory infections:** C. pneumoniae causes pneumonia. C. psittaci causes psittacosis.

## Laboratory diagnosis

**Specimen collection:** Specimen should be collected by scraping the mucosa.

**Culture :** Chlamydiae can be isolated by the following methods: **Animal inoculation, Egg inoculation, Tissue culture**

**Other methods:**

1. immunofluorescence: Direct fluorescent antibody test
2. **ELISA:** Antigen and antibodies can be detected by ELISA.
3. **Molecular tools:** Polymerase chain reaction can be used for detection of chlamydia

## Treatment

Sulphonamides and tetracycline are the drugs of choice. Single dose azithromycin is the drug of choice for non-gonococcal urethritis.