Mycobacterium:

Mycobacteria are aerobic, **acid-fast** bacilli (rods) They are neither gram-positive nor gram-negative (i.e., they are stained poorly by the dyes used in Gram stain). The term *acid-fast* refers to an organism's ability to retain the carbolfuchsin stain despite subsequent treatment with an ethanol–hydrochloric acid mixture. The high lipid content (approximately 60%) of their cell wall makes mycobacteria acid-fast.

MYCOBACTERIUM TUBERCULOSIS

Important Properties:

1- *M. tuberculosis* **grows slowly** (i.e., it has a doubling time of 18 hours, in contrast to most bacteria, which can double in number in 1 hour or less).

2- Media used for its growth (e.g., Löwenstein-Jensen medium) contain complex nutrients (e.g., egg yolk) and dyes (e.g., malachite green).

3- *M. tuberculosis* is an **obligate aerobe**.

4- The acid-fast property of *M. tuberculosis* (and other mycobacteria) is attributed to long-chain fatty acids called **mycolic acids** in the cell wall.

5- **Cord factor** (trehalose dimycolate) is correlated with virulence of the organism.

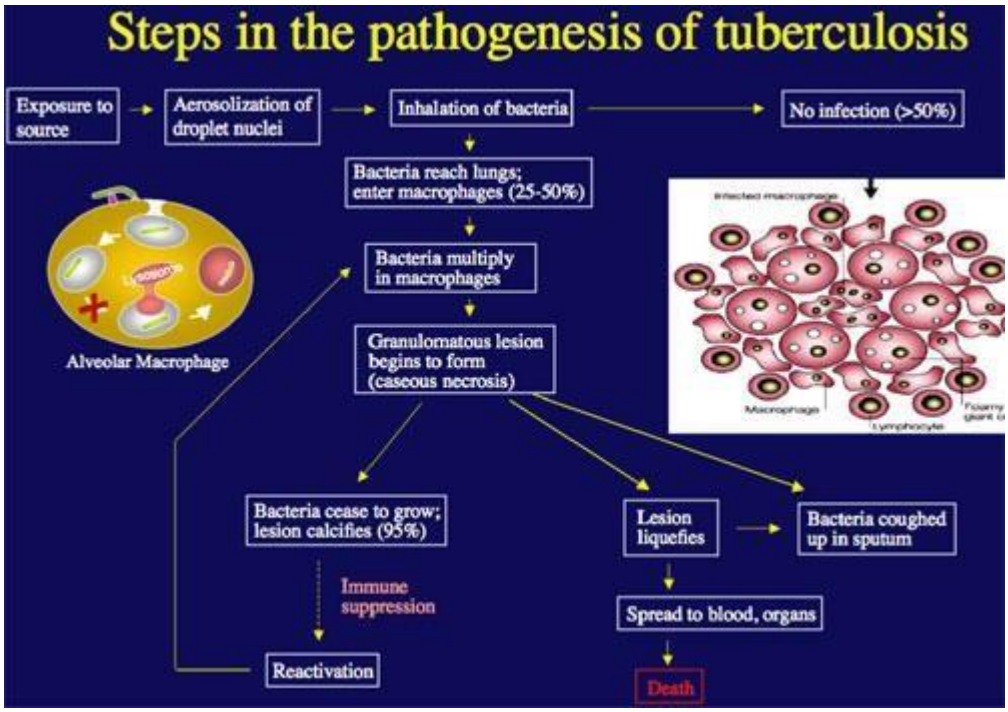
6- *M. tuberculosis* is relatively resistant to acids and alkalis.

Transmission:

M. tuberculosis is transmitted from person to person by respiratory aerosol, and its initial site of infection is the lung. In the body, it resides chiefly within reticuloendothelial cells (e.g., **macrophages**). **Humans are the natural reservoir** of *M. tuberculosis*. Most transmission occurs by aerosols generated by the coughing of "smear-positive" people. In developing countries, *Mycobacterium bovis* also causes tuberculosis in humans.

Pathogenesis:

M. tuberculosis produces no exotoxins and does not contain endotoxin in its cell wall. The organism preferentially infects macrophages and other reticuloendothelial cells. *M. tuberculosis* survives and multiplies within a cellular vacuole called a phagosome. The organism produces a protein called "exported repetitive protein" that prevents the phagosome from fusing with the lysosome, thereby allowing the organism to escape the degradative enzymes in the lysosome.



Lesions are dependent on the presence of the organism and the host response. There are two types of lesions:

(1) **Exudative lesions:** which consist of an acute inflammatory response and occur chiefly in the lungs at the initial site of infection.

(2) **Granulomatous lesions:** which consist of a central area of giant cells containing tubercle bacilli surrounded by a zone of epithelioid cells.

A **tubercle** is a granuloma surrounded by fibrous tissue that has undergone central **caseation necrosis**. Tubercles heal by fibrosis and calcification.

Spread of the organism within the body occurs by two mechanisms:

(1) A tubercle can erode into a bronchus, empty its caseous contents, and thereby spread the organism to other parts of the lungs, to the gastrointestinal tract if swallowed, and to other persons if expectorated.

(2) It can disseminate via the bloodstream to many internal organs.

Clinical Findings:

1- Fever, fatigue, night sweats, and weight loss are common.

2- Pulmonary tuberculosis causes cough and hemoptysis.

3- Scrofula is mycobacterial cervical lymphadenitis that presents as swollen, nontender lymph nodes, usually unilaterally.

4- Erythema nodosum, characterized by tender nodules along the extensor surfaces of the tibia and ulna, is a manifestation of primary infection seen in patients who are controlling the infection with a potent cell-mediated response.

5- Miliary tuberculosis is characterized by multiple disseminated lesions that resemble millet seeds.

6- Tuberculous meningitis and tuberculous osteomyelitis.

7- Gastrointestinal tuberculosis is characterized by abdominal pain and diarrhea.

8-Oropharyngeal tuberculosis.

9- renal tuberculosis.

Laboratory Diagnosis:

1- Acid-fast staining of sputum or other specimens is the usual initial test.

2- cultured on special media, such as Löwenstein-Jensen agar, for up to 8 weeks.

3- Tests are available that detect either the ribosomal RNA or the DNA of the organism.

4- The **luciferase assay**.

Treatment:

1- Multiple drugs critical to treat infection

2- Standard observed short-term therapy for uncomplicated pulmonary TB (rate where acquired resistance <4%):

− First 2 months: rifampin + isoniazid + pyrazinamide + ethambutol (RIPE)

− Next 4 months: rifampin and isoniazid

3- Ethambutol or streptomycin added for possible drug-resistant cases until susceptibility tests are back (if area acquired has >4% drug-resistant mycobacteria)

Prevention:

1- Isoniazid taken for 9 months can prevent TB in persons with infection but no clinical symptoms.

2- Bacille Calmette-Guérin (BCG) vaccine containing live, attenuated organisms may prevent disseminated disease.

3- UV lights or HEPA filters used to treat potentially contaminated air.

Q1- Put true or false ?

1- *MYCOBACTERIUM TUBERCULOSIS* grows slowly .
2- *M. tuberculosis* is an obligate aerobe.
3- The acid-fast property of *M. tuberculosis* is attributed to long-chain fatty acids called mycolic acids in the cell wall.
4- Cord factor (trehalose dimycolate) is correlated with virulence of the organism.
5- *M. tuberculosis* is relatively resistant to acids and alkalis.

Q2- Define a tubercle?

Q3- How can you diagnosis the *MYCOBACTERIUM TUBERCULOSIS*?