

Mycobacterium Tuberculosis Characteristics

Mycobacterium tuberculosis is the bacterium that causes tuberculosis. These bacteria have mycolic acid in their cell walls, so they don't stain well with Gram stain. Special acid fast stains such as carbolfuchsin can be used, which will stain the bacteria red. Lowenstein-Jensen agar is a selective medium used to grow these bacteria in the lab. Serpentine cord factor is a virulence factor expressed by bacteria, that causes them to grow in cord-like arrangements. Primary TB occurs upon first exposure to the bacteria, and can lead to the formation of pulmonary caseating granulomas. When seen on X-ray, a granuloma can be termed a Ghon focus. Bacteria draining into the mediastinal lymph nodes can cause perihilar lymphadenopathy, and this finding with a Ghon focus is termed a Ghon complex. After initial infection, TB often becomes quiescent and can remain undetected in the host for a long time, termed latent TB. Reactivation TB occurs after reactivation of latent disease, and often localizes to the apices of the lungs.



PLAY PICMONIC

Characteristics

Mycolic Acid Cell Wall

Mic Acidic-lemon Wall

Mycobacteria are noted for having a cell wall composed of mycolic acid. This cell wall gives the organisms a waxy coating, making them impervious to gram-staining. Thus, these bacteria are better identified via acid-fast and carbolfuchsin staining.

Acid-fast

Acidic-lemon Running Fast

A commonly known acid-fast stain used to identify *M. tuberculosis* species is the Ziehl-Neelsen stain. Specifically, with a Ziehl-Neelsen stain, these bacteria stain bright red and stand out clearly against a blue background. This phenomenon occurs secondary to their mycolic acid cell wall, making them acid-fast, meaning they will retain stains despite wash with acid and alcohol.

Carbolfuchsin Stain Red

Car-bomb-fuse Stained Red

This stain is a component of the Ziehl-Neelsen stain, and has a high affinity for mycolic acid, working to stain *M. tuberculosis*. Carbol fuchsin is used as a dye to detect acid fast bacteria because it is more soluble in the cells wall lipids than in the acid alcohol. If the bacteria is acid-fast the bacteria will retain the initial red color of the dye because they are able to resist the destaining by acid alcohol.

Lowenstein-Jensen Agar

Low-stein-Jetson

This agar is a special selective medium that allows for the growth of *Mycobacteria* species in the lab, while preventing growth of unwanted pathogens.

Serpentine Cord Factor

Serpent Cord

This is described as smears made from colonies of *mycobacterium TB* form distinctive chains of cells that look like serpentine cords. Cord factor is associated with virulent strains of bacteria, and has been observed to influence immune responses, induce the formation of granulomas, and inhibit tumor growth.

Primary TB

Primary TB

[\(1\) Wand and TB-TV](#)

Primary tuberculosis develops in a previously unexposed person. In most people, the primary infection is contained and mostly asymptomatic. Only around 10% of patients exposed to TB will develop active primary disease. Over a period of weeks, an immune response will slowly build against the bacteria, leading to inflammation and symptoms of lung disease. Constitutional symptoms like fever and weight loss are common. In certain cases, disseminated disease can occur, leading to multisystemic infections and sepsis. Mycobacteria will often lay dormant after the initial infection, and can remain this way for years, which is called latent tuberculosis.

Caseating Granuloma

[Cheese-eating Granny-llama](#)

Histologically, sites of active inflammation are marked by caseating granulomatous inflammation. Granulomas are described as an area of inflammation with lymphocytes surrounding infected macrophages, leading to the formation of giant multinucleated cells in the alveolar lumen. Additionally, in TB these granulomas are associated with development of abnormal cell death, or necrosis, in the center of the tubercles. Grossly, as seen during surgery or autopsy, this has the texture of soft, white cheese and is termed “caseous necrosis,” hence the description of caseating granulomas associated with this disease.

Ghon Focus

[Gong with Focusing-magnifying-glass](#)

Typically in primary tuberculosis, the inhaled bacilli implants in the lower part of the upper lobe and causes a focus of inflammation with consolidation called a “ghon focus.”

Hilar Lymph Nodes

[Hitler with Lymph-limes](#)

Typically, with both inactive and active TB there is enlargement of lymph nodes in one or both hila or within the mediastinum, with or without associated atelectasis or consolidation. This is often reported as bilateral hilar adenopathy on chest X-ray reads.

Ghon Complex

[Complex Gong](#)

Once inoculated in a host, these bacteria drain to regional lymph nodes, causing caseation of lymph nodes. The combination of a ghon focus, which occurs in lung parenchyma, with lymph node involvement, constitutes a “ghon complex.”

Reactivation TB

Reactivation TB

[Reactivation Button on TB-TV](#)

Reactivation of previously latent disease is a common presentation of tuberculosis. For otherwise healthy patients with latent TB, the risk of reactivation can be up to 10% over their lifetime. It occurs more often when the host immune system is weakened, such as by HIV/AIDS, malignancy or immunosuppressive diseases and medications. In reactivated TB, the disease is typically confined to the lungs. There is a lower risk of dissemination as compared to the risk in primary disease.

Reactivation in Apex

[Reactivation Button on Mountain-apex](#)

Secondary TB classically occurs in the apex of the upper lobes, as these organisms are obligate aerobes and the apices of the lungs are well-aerated.