

Mycobacteria, Chlamydia, Mycoplasma, and Legionella

Mycobacteria

Mycobacteria are obligate aerobic bacilli. This makes sense as they most commonly infect the lungs, where Oxygen is abundant.

Cell Wall:

Mycobacteria's cell wall is comprised mainly of Protein-Polysaccharides and Phospholipids. Keep in mind that this cell wall is lipid-laden (i.e., has high lipid content). The high lipid content makes the Mycobacteria Acid-Fast organisms.

There is one class of lipid that only acid-fast organisms have and that is involved in the mycobacterial virulence – The Mycosides. Mycosides comprise 5 subtypes, but the two mycosides of importance are:

- 1- Mycolic acid: is a large fatty acid.
- 2- Waxes: particularly Wax D.

Note: Those are NOT phospholipids. Even though, they are in the slides as are.

Mycobacteria are:

Resistant to: dryness, low acidity, and **alcohol-detergents** *.

Susceptible to: UV light, Heat.

** You will figure out why in the discussion of "What does acid-fast mean?"*

Q: What does acid-fast organism mean?

A: An acid-fast organism is a one with a positive result of acid-fast stain.

Q: How is acid-fast stain used?

A: " In acid-fast stain, a smear of sputum, for example, is covered with the red stain carbolfuchsin and heated to aid dye penetration. Acid alcohol (95% ethanol and 3% HCl) is poured over the smear, and then a counter-stain of methylene blue is applied. The cell wall lipids of the Mycobacterium do not dissolve when the acid alcohol is applied (because it is resistant to low acidity and alcohol detergents, as mentioned earlier), and thus the red stain does not wash off. So acid-fast organisms resist decolorization with acid alcohol, holding **fast** to their red stain, while bacteria that are not acid-fast lose the red stain and take on the blue."

Conclusion:

Red stain means acid-fast positive.

Blue stain means acid-fast negative.

Other info:

- Mycobacteria cause necrosis.
- They are more common in humans. Persons infected are usually asymptomatic.
- They are Domestic in Animals, birds, and environment.

Human/animal Mycobacterial pathogens grow slowly intracellularly (needs 2-6 weeks for visible growth).

Other non-pathogenic mycobacterial species grow more rapidly (needs 3-7 days for visible growth). They can exist in the genital tract or on the skin. *M. Smegmatis* is an example.

Common Mycobacterial pathogens:

1- M.Tuberculosis

2- M.Bovis: is part of the *M.Tuberculosis complex*, which can cause Tuberculosis (comes from animals and dairy products)

3- Atypical mycobacteria: also called the NTM (nontuberculous mycobacteria) or the environmental bacteria. This group has pigmented and non-pigmented species. NTM affects the immunosuppressed persons (like those infected with HIV).

Remember:

"A person may contract pulmonary tuberculosis from inhaling droplets from a cough or sneeze by an infected person. The result is formation of granuloma in lung tissue."

Types of Tuberculosis:

Pulmonary Tuberculosis/ Exudative type:

- Affects mostly children (90% of cases)
- Transmitted via aerosolized droplets from aerosolized secretions of a patient with pulmonary tuberculosis.
- Infection does not necessarily mean disease, so most of the pulmonary TB infections are asymptomatic. Even though, it causes lung lesion (*the CMI responds to the infection and the result is formation of caseous granulomas. These granulomas will heal with fibrosis, calcification, and scar formation.*)
- Patients with hypersensitivity can develop a more potent damage due to the aggressive action of Immune system.

Secondary or Reactivation Tuberculosis/ Active Productive Type:

- Most adult cases of tuberculosis occur after the bacteria have been dormant for some time. It involves the reactivation of old tuberculosis lesions. This is called the reactivation/ secondary tuberculosis.
- It is suggested that the cause for this "reactivation" is a temporary weakening of the immune system.
- Additional info: Many AIDS patients develop tuberculosis in this manner.

- M.Tuberculosis primarily affects the lung but can also cause disease in almost any other tissue. The way it spreads and damages the body depends on the host's immune response.

Lab Diagnosis:

- 1- Direct AFS method is used (Acid-Fast Stain, mentioned earlier.)
- 2- The Biopsy is cultured on Lowenstein-Jensen medium.
- 3- This Biopsy could be from: sputum, urine, pleural fluid, or CSF.

Prevention:

Prevention is done using the BCG vaccine (Bacillus Clamette-Guérin). It is applied on Children.

Treatment:

Patients are treated with a combination of Anti-tuberculosis drugs. The duration of therapy needs 6-24 months for the patient to be considered "cured".