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Mycobacterial Diseases

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Commentary

Cell Physiology of Different Mycobacteria Strains

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DESCRIPTION

Mycobacteria are distinguished by their hydrophobic cell walls that are thick, waxy, and lipid-rich. Because they are hydrophobic, they grow in liquid culture media as fungus-like pellicles, hence the name Mycobacterium - 'fungus bacterium.' Mycobacteria differ from other bacteria in the nature of their cell walls and metabolism, necessitating the use of specific diagnostic tests such as stains, culture media, and identification methods. The cell walls of mycobacteria are extremely thick, with four layers. The innermost layer is made of peptidoglycan, while the remaining layers are made of lipids. The presence of lipid provides bacteria with resistance to acid and alkaline environments, as well as making the cells relatively impermeable to various basic dyes, which must be combined with phenol in order to penetrate the cell wall. Pathogenic strains are dangerous because they can evade immune defense mechanisms, resulting in chronic infections. There are over 60 species in the genus Mycobacterium, which are classified as fast-growing, slow-growing, and the human leprosy *bacillus*, which has not been successfully cultured *in vitro*. Several of the species are obligate parasites, but the vast majorities are saprophytes that live in the environment. Mycobacteria may aid in the decomposition of organic matter, particularly in sphagnum marshes, but no reports of mycobacteria causing food spoilage have been reported. They emit minute amounts of toxic substances and do not cause food poisoning. The obligate parasites are *Mycobacterium tuberculosis* (the human tubercle *bacillus*), *Mycobacterium bovis* (the bovine tubercle *bacillus*), and *Mycobacterium africanum* (a species first described in equatorial Africa with rather variable properties that are intermediate between the other two), as well as variants of these species such as *Mycobacterium microti* (the vole tubercle *bacillus*). Biochemically and genetically all of these tuberculosis complex species are extremely closely related and should be considered variants of a single species. *Mycobacterium leprae* (the pathogen that causes leprosy), *Mycobacterium paratuberculosis* (the pathogen that causes Johne's disease or hypertrophic enteritis in cattle and other ruminants), and *Mycobacterium lepraemurium* are all thought to be obligate parasites (the cause of rat leprosy). Some saprophytic species like *Mycobacterium avium*, Mycobacterium intracellulare, *Mycobacterium scrofulaceum* can cause both animal and human opportunistic infections. The possibility of replication in an inanimate environment cannot be ruled out because *Mycobacterium leprae* is uncultivable and the other two are extremely difficult to cultivate *in vitro*. Mycobacteria culture works best when liquid and solid media are used together. The main opportunist species are *Mycobacterium kansasii*, *Mycobacterium xenopi*, *Mycobacterium malmoense*, and the rapidly growing *Mycobacterium chelonae* and *Mycobacterium fortuitum*. The first two species are closely related and collectively known as the *Mycobacterium avium* Complex (MAC). Despite being primarily saprophytic, MAC are the most pathogenic of the opportunist mycobacteria. Members of this complex cause tuberculosis in birds and lesions in mammals such as pigs, cattle, and deer, particularly cervical lymphadenopathy. *Mycobacterium lepraemurium*, *Mycobacterium paratuberculosis*, and the wood pigeon *bacillus* are all closely related to the MAC (*Mycobaterium avium* subsp. *sylvaticum*), which, like Mycobacterium paratuberculosis, requires mycobactin for *in vitro* cultivation. Other mycobacteria with high nutritional demands that require enriched media for cultivation have recently been described. One of these is Mycobacterium genavense, which was discovered using DNA amplification techniques in patients with Acquired Immuno Deficiency Syndrome (AIDS). This species has also been isolated from pet birds and a dog, and infected pets may pose a health risk to people with severely compromised immune systems. Tuberculosis and leprosy are well-known human diseases, but Buruli ulcer disease and nontuberculous mycobacterial diseases are becoming more prevalent in certain locations. While immunochromatography can distinguish *Mycobacterium tuberculosis* from non-tuberculosis mycobacteria, precise species identification requires molecular techniques. Drug susceptibility testing for *Mycobacterium tuberculosis* and nontuberculous mycobacteria should be performed by experienced laboratories. Molecular detection of rifampin and isoniazid resistance is a reliable and important clinical tool for *Mycobacterium tuberculosis*.

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