Mycobacterial Diseases
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Opinion Article

Non-Tuberculous Mycobacterium (*Mycobacterium marinum*) Disease in Fishes

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DESCRIPTION

Bataillon (1897) isolated acid-fast *bacilli* named Mycobacterium piscium from a tuberculous lesion in a common carp and reported the first report of a Mycobacterium isolated in fish, thought to be *Mycobacterium marinum* (*Cyprinus carpio*). At the philadelphia aquarium, *Mycobacterium marinum* was first isolated and identified from marine fish. *Mycobacterium marinum* was originally thought to only infect marine fishes and was named as such, but it is now known to be a widespread species. The original freshwater isolate of Mycobacterium piscium mentioned above could be an *Mycobacterium marinum* variant. Several other marine Mycobacterium species, including *Mycobacterium platypoecilus*, *Mycobacterium anabanti*, and *Mycobacterium balnei*, were also described. Comparative Sugar fermentative reactions of Mycobacterium piscium with published morphological, cultural, and pathogenic data of other marine Mycobacterium species suggests that they were all synonymous with *Mycobacterium marinum*, even though Mycobacterium piscium has not been recognised as a species because its type culture is no longer available.

Pathogenesis

The availability of fish models (goldfish and zebrafish) that mimic a natural mycobacterial infection allows researchers to investigate the pathogen-host interaction. New infection models have been described, including *Drosophila melanogaster* (in which *Mycobacterium marinum* infection is lethal at low doses), adult leopard frogs (*Rana pipiens*), and embryonic zebrafish (*Danio rerio*). *Mycobacterium tuberculosis* infections in these animals are strikingly similar to *Mycobacterium tuberculosis* infections in humans. The ability to cause both acute and chronic diseases, as well as the formation of granuloma-like lesions in the host, are particularly conserved. These models, however, were mostly used as surrogates for studying tuberculosis physiopathology or screening new antituberculosis drugs, and only rarely for *Mycobacterium marinum* infection itself. *Mycobacterium marinum* is an intracellular pathogen that grows in non-acid (pH 6.1 to 6.5) phagosomes that do not fuse with the lysosome. Given that the two species are genetically related, it is likely that analogous molecular mechanisms are involved in these organisms' survival in a hostile cell environment. *Mycobacterium marinum* is thus a very useful model system for studying mycobacterial intracellular survival and possibly other host-pathogen interactions associated with tuberculosis, such as innate susceptibility. *Mycobacterium marinum* has been found in activated macrophages in granulomas, according to ultrastructure studies.

Culture specific characteristics of *Mycobacterium marinum*

- *Mycobacterium marinum*, like any other mycobacteria, is an aerobe. prefers glycerol, pyruvate, and glucose as carbon sources, but it can also use ethanol.
- *Mycobacterium marinum*'s optimal growth temperature is 30°C, whereas 37°C results in small colonies or no growth.
- The growth rate in primary culture may be slow, and positive culture may be obtained only after several weeks of incubation.
- The growth rate in subculture is between 1 and 2 weeks, but can reach 4 to 5 days due to its rapid ability to adapt to laboratory conditions.
- *Mycobacterium marinum* grows more slowly than *Mycobacterium tuberculosis*. It grows in all mycobacterial growth media without any additives or only 2 to 5% oleic acid-albumin-dextrose-catalase instead of 10% for *Mycobacterium tuberculosis*, and it also grows on blood-containing agar. Some of the strains may grow on ordinary culture media after subcultures.
- Although its growth is oxygen-dependent similar to other mycobacteria, 2% to 5% carbon dioxide in the gas phase above the medium improves growth.

Manifestations *Mycobacterium marinum* disease infection

Disease in fish: *Mycobacterium marinum* disease is very common in fish, especially in aquarium fish. There is some evidence that the gastrointestinal tract may be the primary route of infection, and poor diet and stress have been shown to exacerbate mycobacterial infections in zebrafish. The infection's severity ranges from chronic infection with a low mortality rate to an acute form in which the entire population died. Acute fulminating disease is uncommon, with rapid morbidity and mortality and few clinical signs.

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Mycobacterium marinum infection is more commonly a chronic, progressive disease that can take years to manifest as a visible illness. Affected fishes exhibit behavioural changes such as separation from other fishes and refusal of food. They may develop skin ulcers or pigment changes, as well as spinal curvature. Exophthalmia, either unilateral or bilateral, is also a common symptom. *Mycobacterium marinum* infection in fish is a systemic disease that can affect virtually any organ system, but particularly the spleen, kidneys, and liver.

CONCLUSION

Surveillance of *Mycobacterium marinum* infection should be carried out in at least some high-risk countries, because the infection rate is expected to rise as a result of fishkeeping as a hobby and aquarium tourism. Simple surveillance could be based on cases confirmed by culture. Bacteriology laboratories, dermatologists, and infectious disease specialists should all play an important role in case identification. Because *Mycobacterium marinum* infection cannot be transmitted from person to person, preventing inoculation from the environment is the primary strategy for eradicating the disease. Simple recommendations like hand protection and hygiene measures, as well as fish tank and aquarium maintenance, appear worthy of widespread dissemination and evaluation.