

Mycobacterium marinum Infections of the Upper Extremity

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Learning Objectives: After studying this article, the participant should be able to: 1. Appreciate the pathophysiology of *Mycobacterium marinum* infection. 2. Identify patients infected with *M. marinum*. 3. Recognize factors that can lead to early diagnosis and treatment of infection. 4. Plan successful therapeutic and surgical management.

A significant number of patients infected with *Mycobacterium marinum* have been treated at the Curtis National Hand Center in Baltimore, Maryland. The purpose of this study was to review the authors' experience with *M. marinum* infections of the upper extremity. Twenty-nine patients were identified and their charts were reviewed for all factors related to diagnosis and treatment. The most common presenting symptoms were swelling ($n = 25$) and pain ($n = 14$). Only 69 percent of patients could correlate their injury with aquatic activities. The mean time from injury to diagnosis was 5.2 months. Acid-fast bacilli stains were positive in only 22 percent of specimens. The mean number of procedures was 1.75, with the majority being tenosynovectomy. The mean duration of antibiotic therapy was 6 months. Clinical history, pathological evaluation, and a high clinical suspicion can lead to early diagnosis and introduction of antibiotics. The authors' patients were successfully treated with 6 months of antibiotic therapy and early surgical intervention. (*Plast. Reconstr. Surg.* 115: 55e, 2005.)

Mycobacterium marinum is one of several atypical *Mycobacterium* species that result in slowly developing cutaneous infections. It is a natural

inhabitant of both fresh and salt water and is a known pathogen of fish. Although first isolated from a fish tank in Philadelphia, it has since been identified along the Atlantic, Pacific, and Gulf coasts.¹⁻⁴ In particular, the Chesapeake Bay has been found to be endemic for *M. marinum*.^{5,6} Unfortunately, the diagnosis and management of an *M. marinum* infection can prove to be quite difficult. At the Curtis National Hand Center in Baltimore, Maryland, a significant number of patients infected with *M. marinum* have been treated. The goal of this study is to present our experience with *M. marinum* infections of the upper extremity and a comprehensive review of the literature regarding the diagnosis and treatment of this infection.

PATIENTS AND METHODS

Patients were determined from Maryland State Laboratory and Union Memorial Hospital records as well as from Curtis National Hand Center physician charts from 1992 to 2003. Only patients who had completed treatment and were considered to be free from infection at the time of review were evaluated. Twenty-nine patients were identified with culture-positive upper extremity *M. marinum* infections. None were considered immunocompromised. Follow-up ranged from 6 months to 10 years. Charts were reviewed for demographics, presenting complaint, location of injury,

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aquatic activities, time to hand surgeon referral, time to first surgical procedure, number and type of procedures, severity of infection, antibiotic therapy, and treatment before Hand Center evaluation.

RESULTS

The patient group consisted of 26 men and three women ranging in age from 28 to 70 years (mean age, 50 years). The most common presenting symptoms were swelling ($n = 25$) and pain ($n = 14$) (Table I). All lesions at the time of evaluation were type II or III according to Hurst's classification.⁷ There were 30 sites of infection: the thumb in four patients, the index finger in seven patients, the middle finger in 14 patients, the ring finger in two patients, and the small finger, wrist, and elbow in one patient each. Only 20 patients (69 percent) could correlate their injury with aquatic activities; five could not recall an association and four denied sustaining any trauma.

Before evaluation, all patients were seen by an outside primary care provider or surgeon. All patients were given one or more trials of short-term antibiotics; most received adjuvant therapy with nonsteroidal anti-inflammatory agents, 10 underwent local steroid injection, and two were given one or more trials of oral steroids. Carpal tunnel release was performed in three patients, aspiration in three patients, A1 pulley release in two patients, incision and drainage in six patients, and synovectomy in one patient.

The mean time between injury and evaluation was 3 months (range, 1 week to 10 months). Although the mean time between initial examination and surgery was 28 days, 18 of 29 patients (62 percent) underwent surgery within 2 weeks and 21 of 29 patients (72 percent) underwent surgery within 4 weeks. The total number of procedures for these patients was 51 (mean, 1.75), with tenosynovectomy being the most common (Table II). Only 22 percent had a positive stain for acid-fast bacilli,

TABLE I
Presenting Symptoms in Patients with *Mycobacterium marinum* Infections of the Upper Extremity

Symptom	No. of Patients
Swelling	25
Pain	14
Erythema	2
Mass	1
Weakness	1
Decreased range of motion	1

TABLE II

Procedures Performed for Diagnosis and Treatment of *Mycobacterium marinum* Infections of the Upper Extremity

Procedure	No. of Cases
Tenosynovectomy	25
Simple débridement	8
Incision and drainage	6
Excisional biopsy of lesion, mass, or bursae	5
Radical débridement (includes tendon excision)	4
Incisional biopsy	2
Amputation (ray)	1

and only 36 percent of the pathology specimens demonstrated identifiable granulomas. The mean time from injury to definitive diagnosis was 5.2 months (range, 1 to 14 months).

After evaluation an infectious disease consultation was obtained for all patients. The mean duration of antibiotic therapy was 6 months (range, 4 to 12 months). The most common antibiotics used were ethambutol (72 percent), rifampin (72 percent), and clarithromycin (41 percent) (Table III). In 17 of 29 cases (59 percent) ethambutol plus rifampin was the primary antibiotic therapy. Antimicrobial therapy consisted of two antibiotics in 62 percent of cases and three antibiotics in 31 percent of cases. In 81 percent of cases antibiotics were started within 4 weeks of the initial surgical procedure.

There were three antibiotic complications. Rifampin use resulted in chemical hepatitis in one patient and leukopenia in another. Both effects resolved after discontinuation. Gastrointestinal distress resolved after discontinuation of clarithromycin in another patient.

DISCUSSION

In 1826 Laennec described a cutaneous *Mycobacterium* infection.⁸ One hundred years later Aronson isolated the organism from saltwater fish in a Philadelphia aquarium and named it

TABLE III
Antibiotic Therapy for Upper Extremity *Mycobacterium marinum* Infections

Antibiotic	Percentage of Use
Ethambutol	72
Rifampin	72
Clarithromycin	41
Trimethoprim/sulfamethoxazole	14
Ciprofloxacin	14
Azithromycin	10
Doxycycline	10
Minocycline	3
Tetracycline	3

Mycobacterium marinum.¹ Since that time the organism has been found in multiple aquatic environments, including fish tanks and swimming pools, thus leading to the names “fish fancier’s finger,” “fish-tank granuloma,” and “swimming pool granuloma.”^{9–11} Although it is found worldwide, it tends to be prevalent in the warmer waters of temperate climates such as the Chesapeake Bay.

The actual incidence of *M. marinum* is unknown, but several reports have placed it at 0.05 to 0.27 per 100,000.^{3,12} In a previous study the incidence of *M. marinum* in Maryland regions bordered by the Chesapeake was found to be 1.3 per 100,000 per year.⁶ The actual incidence may be higher secondary to underreporting.

For the infection to develop it is necessary to have a disruption in the skin, although patients commonly cannot recall even sustaining an injury. A previous study, however, suggests that most exposures do not result in disease.¹³ After inoculation, infections are initially confined to the skin and superficial subcutaneous tissue. Because the optimal temperature for growth of *M. marinum* is 30°C to 32°C, infections are typically confined to the extremities.

After an incubation period of 2 to 6 weeks the disease may develop into certain characteristic types, as described by Hurst et al.⁷ Type I lesions are small, painless, bluish-red papules 1 to 2 cm in diameter.^{14,15} Typically these lesions are self-limited, but they may take several months to resolve. Type II lesions are single or multiple subcutaneous granulomas, with or without ulceration (Fig. 1). Type III lesions are



FIG. 1. This single subcutaneous granuloma with ulceration illustrates a type II *Mycobacterium marinum* lesion.

deeper infections involving the tenosynovium, bursa, bones, or joints (Figs. 2 and 3). Another more uncommon type may occur in up to 20 percent of cases. This “sporotrichoid” form of *M. marinum* is characterized by nodular or ulcerating lesions that spread proximally up lymphatics to regional lymph nodes. This form tends to be more persistent and may not resolve in immunocompromised patients.¹⁶ None of our patients presented with type I lesions. This likely indicates that these lesions either resolve their infection or progress to type II or III, thus requiring evaluation by a hand surgeon.

The diagnosis of a *M. marinum* cutaneous infection is often difficult and is the primary reason for delay in appropriate treatment. The differential diagnosis includes rheumatoid arthritis, lupus arthritis, gout, sarcoidosis, infection with other atypical mycobacteria, sporotrichosis, *Nocardia* infection, tularemia, leishmaniasis, cat-scratch fever, skin tumors, and foreign-body reactions.^{16,17} A thorough history with a focus toward aquatic activities, handling of seafood, residence near water, or home aquariums is paramount. Our study indicates that as many as 31 percent of patients may not recall an association with aquatic activities or even having sustained trauma. This is likely a result of the prolonged incubation period of the organism. A patient history consisting of a lengthy treatment with or without surgery, antibiotics, nonsteroidal anti-inflammatory drugs, or steroids and an unresolved swelling or pain should raise considerable suspicions.

Presurgical evaluation consists primarily of a thorough examination. Results of laboratory studies, such as white blood cell counts, are typically normal. Standard roentgenograms are necessary to rule out arthritic changes or foreign bodies. The use of nuclear medicine studies such as the three-phase bone scan, indium leukocyte scintigraphy, and various other technetium modalities may lead to equivocal results.^{18–22} In general, radiographic imaging, other than standard roentgenograms, is of little benefit. In the mid-1980s a *M. marinum* skin test (purified protein derivative of tuberculin platy) was developed. Initially it was found to be positive in up to 70 percent of culture-proven infections.⁷ Further studies found it to be nonspecific and difficult to interpret, however, and it was subsequently discontinued.²³

The most reliable and accurate method of diagnosis is through tissue biopsy. At the time



FIG. 2. A 47-year-old man with a 5-month history of recurrent dorsal wrist swelling and pain.



FIG. 3. Same patient as shown in Figure 2. Intraoperative examination of the patient's extensor tendons revealed a significant type III *Mycobacterium marinum* infection.

of biopsy the surgeon should give serious consideration to débridement of the subcutaneous tissue and tenosynovium. On gross inspection any evidence of inflammation warrants resection to healthy tissue (Fig. 4). Specimens obtained from the deepest aspect of the lesion site are stained with Ziehl-Neelsen stain and evaluated. Our study demonstrates that the Ziehl-Neelsen stain was positive in only 22 percent of specimens. In these specimens there was no correlation with the severity of infection

or between the time of injury and time of biopsy (range, 7 weeks to 12 months). Previous histological studies suggest that granulomata may be present in less than 50 percent of specimens.¹⁶ If present they tend to be poorly formed and present only after 6 months of infection.²⁴ In contrast, our cohort demonstrated granulomata in 36 percent of specimens and all but one were within the first 6 months of the infection. The majority of these specimens came from patients who underwent extensive tenosynovectomy and débridement at the initial surgery. This indicates that more severe infections (e.g., type III), which require more extensive débridement, are more likely to demonstrate granulomas on pathological evaluation regardless of the length of infection.

Tissue must be cultured on Löwenstein-Jensen medium at 30°C to 32°C. All of our patients had positive cultures, but typically cultures are only positive in 70 percent to 80 percent of cases.^{16,25} Our cultures took an average of 5.1 weeks for positive identification, thus adding to the typically prolonged delay in definitive diagnosis.

Because of the significant delay in obtaining positive cultures, antibiotics are initially chosen empirically. The history, physical examination, gross appearance of the tissues at surgery, and initial pathology findings are usually sufficient to make the diagnosis. In our patients, *M. marinum* infections were most susceptible to ethambutol, rifampin, and clarithromycin. Two or three antibiotics were started perioperatively and continued for an average period of 6 months. Adjustments were made according to culture sensitivities and patient tolerance. Patients should be followed closely, and

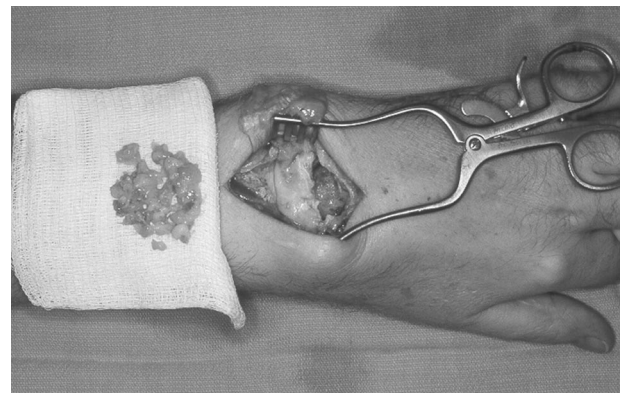


FIG. 4. Same patient as shown in Figures 2 and 3. The patient required extensive débridement of the dorsal wrist soft tissues to eradicate the infection.

if there is evidence of continued infection, further débridement is necessary.

CONCLUSIONS

The diagnosis of *M. marinum* in the upper extremity can be elusive and must be based primarily on a strong clinical suspicion. Unfortunately culture and pathology results can be equivocal or even falsely negative. The initial surgical management should consist of débridement of all subcutaneous tissues, including extensive excision of the tenosynovium. Unfortunately, *M. marinum* is quite fastidious and even extensive débridement to normal, healthy tissue may not eradicate the infection. An infectious disease specialist well versed in the behavior of the organism should be consulted. Antibiotics must be started on completion of the initial surgical procedure and continued for a minimum of 6 months. Close follow-up for at least 1 year after completion of antibiotics is necessary to ensure eradication of the infection.

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