Incubation Period and Sources of Exposure for Cutaneous *Mycobacterium marinum* Infection: Case Report and Review of the Literature

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The diagnosis of cutaneous *Mycobacterium marinum* infection is often delayed for months after presentation, perhaps because important clinical clues in the patient’s history are frequently overlooked. Knowledge of the incubation period allows the clinician to target questions about the patient’s history. Prompted by a case with a prolonged incubation period, we sought to determine more precisely the incubation period of *M. marinum* infection. The MEDLINE database for the period 1966–1996 was searched for information regarding incubation period and type of exposure preceding *M. marinum* infection. Ninety-nine articles were identified, describing 652 cases. Forty cases had known incubation periods (median, 21 days; range, 5–270 days). Thirty-five percent of cases had an incubation period ≥30 days. Of 193 infections with known exposures, 49% were aquarium-related, 27.4% were related to fish or shellfish injuries, and 8.8% were related to injuries associated with saltwater or brackish water. Because the incubation period for cutaneous *M. marinum* infection can be prolonged, patients with atypical cutaneous infections should be questioned about high-risk exposures that may have occurred up to 9 months before the onset of symptoms.

*Mycobacterium marinum* is a well-described cause of cutaneous infection manifested by cutaneous ulcers, nodules, or nodular lymphangitis, usually following lacerations or abrasions exposed to freshwater or salt water or injuries related to fish spines. If untreated, such infections can result in significant morbidity [1–5]. Unfortunately, the correct diagnosis is commonly delayed [6–8]. Clues in the clinical history such as exposure to fish, natural bodies of water, or swimming pools can expedite diagnosis and therapy in cases presenting with cutaneous infections.

Knowledge of the incubation period is helpful because it allows the clinician to target questions about the patient’s history. Most reviews of the subject describe an incubation period of ~3 weeks [9–12]. Prompted by a case in which the incubation period was prolonged, we sought to determine more precisely the incubation period for *M. marinum* by carefully searching the published literature for detailed information regarding cases with known incubation periods after a recognized exposure.

**Case Report**

The patient was a 42-year-old immunocompetent male resident of Central Virginia who worked in a pharmaceutical plant as a maintenance supervisor. In mid-October 1994 the patient developed a tender erythematous nodule on the dorsal aspect of his right fourth finger, just proximal to the base of the fingernail. He sought medical attention for the lesion and over the ensuing 6 weeks was prescribed several courses of antibiotics, including cephalexin, ciprofloxacin, amoxicillin/clavulanate, and erythromycin, but these did not lead to improvement.

Over this period of time the nodule on the finger ulcerated, and he developed swelling, erythema, and tenderness on the dorsum of the right hand, followed by the appearance of multiple tender, erythematous nodules on the right forearm that followed a linear progression from the dorsum of the right hand, extending over the medial aspect of the forearm to the elbow (see figures 1 and 2). There was shotty epitrochlear adenopathy on the right.

There were no systemic complaints. The patient had no history of medical illness and had no risk factors for HIV infection. In the week before the onset of his symptoms the patient had spent time in the woods chopping firewood, but he did not specifically recall any insect bites or hand or finger injuries. The patient denied any fish or animal exposure in the 2 months before the onset of symptoms. His teenage daughter had pet snakes and turtles within the household, but the patient had never been in direct contact with these animals or their containers. There was no history of travel outside the United States.

A biopsy of one of the lesions revealed granulomatous inflammation, but no organisms were identified by gram, mycobacterial, and fungal stains. While cultures were incubating, the patient started empirical therapy with itraconazole on the basis of a presumptive diagnosis of sporotrichosis. After 2 weeks of incubation, the cultures incubated at 31°C yielded an acid-fast bacterium identified as *M. marinum*.

The patient was subsequently questioned about potential exposures and recalled that 90 days before the onset of symp-
toms he had been pinched on the right fourth finger by a crab while fishing on the South Carolina coast. The injury deeply penetrated the skin and the proximal fingernail bed on the dorsal aspect of the finger. The wound healed uneventfully over ~1 week following the injury, and the patient had no further exposure to natural bodies of saltwater or freshwater, fish, swimming pools, or aquariums before the onset of symptoms. The nodule that appeared 3 months later and prompted him to seek medical attention was in the precise location of the crab-pinch injury.

Itraconazole was withdrawn and the patient was treated with rifampin and ethambutol. Gradual improvement occurred, but therapy continued for 12 months before the lesions completely resolved.

Results

We reviewed 99 articles published from 1962 through 1996, which described 652 cases. There were 40 cases reported (including the current one) for which precise incubation periods were given [13–39]. The median incubation period was 21 days (mean, 30.1 days; range, 5–270 days) (figure 3). The 25th percentile for incubation period was 8.5 days, the 75% percentile was 30 days, and the 90th percentile was 60 days.

The presumed sources of exposure for 193 infections reported from 1962 through 1996 are shown in table 1. Ninety-five infections (49.2%) were aquarium-related, 53 (27.4%) were related to fish or shellfish injuries, and 17 (8.8%) were related to injuries associated with saltwater or brackish water sources. Only 5 infections (2.6%) were due to swimming pool–associated injuries, whereas 15 (7.8%) were associated with injuries exposed to other freshwater sources (see table 1). Seventy-two percent of all published case reports did not include a description of exposure to a particular source.

Discussion

The correct diagnosis of cutaneous *M. marinum* infection can be difficult for the clinician. Because the presentation is often insidious and nonspecific, key historical information may not be obtained, and the diagnosis is therefore commonly delayed. The mean duration of symptoms before correct diagnosis is ~3–4 months [7, 8]. This is of clinical importance since untreated *M. marinum* infections can result in significant morbidity, including loss of joint mobility due to osteomyelitis and...
Otherc 2 (5) 6 (3.9) 8 (4.1)

Injury associated with
Skin injury and exposure to
of
injury (1), skin injury by slate in coal mine (1), playground asphalt injury (1),
exposure.

watering trough (1), water pump (1), cleaning water of unspecified source (1),

Table 1. Presumed source of exposure for cutaneous Mycobacterium marinum infections reported in the English-language literature, 1962–1996 [7–9, 13–68].

<table>
<thead>
<tr>
<th>Presumed source</th>
<th>Specified incubation period</th>
<th>Unspecified incubation period</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquarium&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17 (42.5)</td>
<td>78 (51)</td>
<td>95 (49.2)</td>
</tr>
<tr>
<td>Freshwater</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Not specified</td>
<td>15</td>
<td>78</td>
<td>93</td>
</tr>
<tr>
<td>Injury associated with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine shellfish</td>
<td>10 (25)</td>
<td>15 (10)</td>
<td>25 (12.9)</td>
</tr>
<tr>
<td>Shrimp</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Barnacle</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Crab</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Oyster</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Fish spine or tooth</td>
<td>5 (12.5)</td>
<td>23 (15)</td>
<td>28 (14.5)</td>
</tr>
<tr>
<td>Saltwater fish</td>
<td>4</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Freshwater fish</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Not specified</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Skin injury and exposure to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saltwater</td>
<td>0</td>
<td>13 (8.5)</td>
<td>13 (6.7)</td>
</tr>
<tr>
<td>Swimming pool water</td>
<td>2 (5)</td>
<td>3 (2.0)</td>
<td>5 (2.6)</td>
</tr>
<tr>
<td>Other freshwater&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3 (7.5)</td>
<td>12 (7.8)</td>
<td>15 (7.8)</td>
</tr>
<tr>
<td>Brackish water</td>
<td>1 (2.5)</td>
<td>3 (2.0)</td>
<td>4 (2.1)</td>
</tr>
<tr>
<td>Other&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2 (5)</td>
<td>6 (3.9)</td>
<td>8 (4.1)</td>
</tr>
</tbody>
</table>

<sup>a</sup> In 61 of the 95 cases the presumed exposure was an aquarium, but no specific skin injury before or during aquarium exposure was recalled. In all other cases a specific skin injury had occurred immediately before or during aquarium exposure.

<sup>b</sup> Includes natural bath springs (4 cases), lake (3), river (1), manhole cover (1), watering trough (1), water pump (1), cleaning water of unspecified source (1), well water (1), sewer pipe (1), and irrigation reservoir (1).

<sup>c</sup> Includes timber injury (2 cases), ceramic tile injury (1), nail injury (1), knife injury (1), skin injury by slate in coal mine (1), playground asphalt injury (1), and laboratory needlestick injury involving a syringe containing a pure culture of Mycobacterium marinum (1).

The spectrum of exposures associated with cutaneous M. marinum infection was very similar among cases with reported incubation periods and those with unspecified incubation periods. According to the literature, 85% of all known exposures belong to 1 of 3 categories: aquarium exposure, fish- or shellfish-associated injuries, and injuries associated with saltwater or brackish water. Ninety-six percent of published cases with known exposures were accounted for if injuries associated with swimming pools or other freshwater sources other than tap water were included.

It is possible that exposure to some other reservoir may also lead to infection, since many published reports either were unable to identify the exposure or did not include exposure information. It remains possible, however, that exposure to a known reservoir of M. marinum was missed in such cases because of a prolonged incubation period and lack of questioning or memory regarding distant events. Attempts to isolate M. marinum from tap water have been unsuccessful [69–72].

Before 1962, most cutaneous M. marinum infections reported in the literature involved swimming pool–associated injuries, including 2 large outbreaks involving almost 350 patients [73, 74]. It is interesting that the literature after 1962 contains relatively few reports of swimming pool–associated infection, a circumstance suggesting that this source of exposure may now be relatively uncommon. A possible explanation for the decline in reported pool-associated cases is the improvement in swimming pool water–disinfection practices in recent decades. Many of the early cases of swimming pool–associated M. marinum infection were attributed to exposure to pools with inadequate chlorination [73, 75].

Figure 3. Frequency distribution of published incubation periods for cutaneous Mycobacterium marinum infections reported in the English-language literature, 1962–1996.
Although *M. marinum* appears to be relatively resistant to chlorine under laboratory conditions, surviving brief periods of exposure to free chlorine concentrations up to 1.5–2.0 mg/L [76]. *M. marinum* is rarely found in swimming pool water with free chlorine concentrations ≥0.6 mg/L [69, 75, 76]. In 1 report, *M. marinum* was repeatedly isolated from a swimming pool with chlorine concentrations ≈0.2 mg/L; after the chlorine level was increased, *M. marinum* was eliminated from the water [75]. The Centers for Disease Control and Prevention has recommended that concentrations of free chlorine in swimming pool water be kept between 0.4 and 1.0 mg/L [77] and that concentrations in spa and hot tub water be kept between 2.0 and 5.0 mg/L [78].

Implementation of these recommendations, which would maintain chlorine concentrations at or near levels that appear to prohibit the growth of *M. marinum* in swimming pools, may account for the decrease in reports of swimming pool-associated cases that have been more recently reported. The Centers for Disease Control and Prevention has recommended that concentrations of free chlorine in swimming pool water be kept between 0.4 and 1.0 mg/L [77] and that concentrations in spa and hot tub water be kept between 2.0 and 5.0 mg/L [78].

Physicians should be aware that the incubation period for cutaneous *M. marinum* infection, although usually <4 weeks, can be as long as 9 months. Patients with atypical cutaneous infections, especially those with nodular lymphangitis, should be questioned about skin injuries associated with aquariums, fish, shellfish, salt- or brackish water, swimming pools, or natural bodies of freshwater that may have occurred recently or many months before the onset of symptoms. Such questions may identify exposures that would otherwise be overlooked and might therefore prevent unnecessary complications by expediting diagnosis and appropriate therapy.

References

35. Adams RM, Remington JS, Steinberg J, Seibert JS. Tropical fish aquariums:


