Mycobacterium marinum infection from sea monkeys

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A case of cutaneous *Mycobacterium marinum* infection acquired from *Artemia nyos* (sea monkeys) is presented. The infection was unresponsive to initial antimicrobial therapies. A biopsy of a lesion revealed granulomatous inflammation with cultures that subsequently grew *M. marinum*. A three-month course of clarithromycin provided complete resolution.

Key Words: Brine shrimp; Fish tank granuloma; *Mycobacterium marinum*

In 1926, acid-fast bacilli were identified in the tubercles of dead fish in the Philadelphia Aquarium (Pennsylvania, USA) (1). These organisms differed from previously known mycobacteria and were given the name *Mycobacterium marinum*. Subsequently, an outbreak among the Mexican platyfish, *Platyepocilus maculatus*, was reported in 1942 and the etiological organism was named *Mycobacterium platyepocilus* (2). Through the 1940s and 1950s there were numerous reports of granulomatous skin lesions resulting from abrasion acquired in swimming pools, and this condition became known as 'swimming-pool granuloma'. In 1954, *Mycobacterium balnei* was identified as the causative organism (3). In 1961, a mother and son acquired granulomatous nodules on their hands as a result of *M. balnei* infection following injuries from the metal band lining the top of a tropical fish tank (4). Three additional similar cases were reported in 1970 and, thus, the term 'fish tank granuloma' was used to describe this infection (5). Consequently, *M. marinum*, *M. platyepocilus* and *M. balnei* were shown to have the same taxonomical identity and are now all referred to as *M. marinum* (6). We present a case of cutaneous *M. marinum* infection acquired from *Artemia nyos* (sea monkeys).

CASE PRESENTATION

A 43-year-old female homemaker sustained a laceration to the distal phalanx of her right third digit. She subsequently developed erythema of that digit and sought medical attention within several days. Over the next six weeks, she was prescribed various courses of oral and intravenous antibiotics by her family physician, as well as emergency room physicians, including cephalexin, cefazolin and clindamycin.

Despite these treatments, within two weeks the erythema progressed up her right forearm and reddish, purplish nodules had developed on her right third finger as well as her forearm. One of these nodules was incised and drained, but no pus was obtained.

Due to a lack of response to empirical antibiotics, she was referred to an infectious diseases specialist and was seen seven weeks following onset of the erythema. On initial assessment in the infectious diseases clinic, the patient was noted to be afebrile with an unremarkable general examination. Five nodular lesions were noted on the right hand and forearm – one at the base of the nail of the right third digit (Figure 1), one in the region of the third metacarpophalangeal joint

Une infection à *Mycobacterium marinum* transmise par des crevettes des salines

Les auteurs présentent un cas d'infection cutanée à *Mycobacterium marinum* transmise par des *Artemia nyos* (crevettes des salines). L'infection n'a pas répondu au traitement antimicrobien initial. Une biopsie de la lésion a révélé une inflammation granulomateuse, et les cultures ont ensuite été positives à *M. marinum*. Grâce à un traitement de trois mois à la clarithromycine, l'infection a complètement disparu.

Figure 1) Photographs demonstrating the nodular sporotrichoid rash involving the right hand

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Figure 2) Biopsy demonstrating a granulomatous reaction in a multinucleated giant cell

and three along the right forearm. The nodules were purplish/blue in colour. They were rubbery, mobile, nontender and nonfluctuant.

Further history revealed that the patient did not recall any exposures to soil, gardening, rose bushes, aquariums, fish or shell-fish, salt-water, brackish water, swimming pools or other freshwater sources. She had not traveled outside of North America. The infectious diseases specialist's initial impression was a sporotrichoid march due to *M marinum* infection, despite a negative exposure history.

A biopsy of one of these nodules was performed, and the pathology showed chronic granulomatous reaction with acute and chronic inflammation, presence of multinucleated giant cells of both foreign body and Langhans type (Figure 2). Auramine-rhodamine stains revealed the presence of acid-fast bacilli. Cultures for fungus and bacteria were negative. Culture for acid-fast bacilli yielded *M marinum*. The patient was treated with oral clarithromycin 500 mg twice daily for three months and had complete resolution of her nodules with no subsequent recurrences.

Following the initial interview with the infectious diseases specialist, the patient later recalled cutting her right third digit while cleaning a broken glass bowl containing sea monkeys, or *Artemia nyos*, which had been spilled on her kitchen floor. This occurred approximately one month before the onset of her illness. We believe this to be the most likely source of her *M marinum* infection.

DISCUSSION

M marinum cutaneous infections have been reported from exposure to contaminated water in aquariums or unchlorinated swimming pools. This has led to the nickname of 'swimming pool granuloma' or 'fish tank granuloma' (7,8). Identified vectors include dolphins, snails, water fleas, saltwater and freshwater fish, oysters and shrimp (7,9,10). Sea monkeys are a type of brine shrimp and the scientific name is *A nyos* in recognition of the New York Ocean Science (NYOS) Laboratories where they were developed. In the present case, sea monkeys (*A nyos*) appear to be the most likely source of *M marinum*. The water in which the sea monkeys were living was not believed to be the source because previous attempts to isolate *M marinum* from tap water have been unsuccessful (11,12).

Cutaneous mycobacterial infections associated with shrimp have been previously reported, with both *Mycobacterium kansasii* and *M marinum* (13,14). A review of the literature by Jernigan and Farr (15) identified nine cases of *M marinum* infection secondary to injury associated with shrimp. To our knowledge, however, there have been no reported cases of *M marinum* infection associated with exposure to brine shrimp or the related *A nyos*.

The diagnosis of this infection can be difficult and is highly dependent on clinical history because often there is a nonspecific

presentation. The patient described above had a positive acid-fast bacilli smear and culture of the organism, which is not typical. Older studies suggest acid-fast bacilli presence ranges from 0% to 100%, with positive culture in 70% to 80% (16). Cheung et al (17) demonstrated only 38% and 42% of infected patients having a positive smear and culture, respectively. If one suspects *M marinum*, cultures must be set up at cooler temperatures (28°C to 32°C) and should be kept for six weeks (16,18). With advancing technology, there is also the possibility of polymerase chain reaction and ELISA testing to aid in rapid identification of the organism (19).

Lesions often have varying degrees of epidermal hyperplasia, with parakeratotic or hyperkeratotic scales, depending on the duration of the infection (20). Histology of the lesion's cells often shows the dermis containing granulomas with multinucleated giant cells, although this may not be present if the lesion has been present for less than six months and is composed of lymphocytes, epithelioid cells and diffuse cell infiltrate (16,20). Langhans's giant cells occasionally occur, and secondary infection and ulceration may be present (20).

The presentation of infection with *M marinum* in immunocompetent hosts can be varied, ranging from a single painless nodule to widespread dissemination, although the latter is uncommon (16,17,21). More often, patients present with single (most common) or multiple superficial nodules or papules, which are usually painless (16,18). This usually occurs two to four weeks after inoculation but can occur up to nine months after inoculation (9,15). Beginning as a violet papule, they often progress to a shallow ulceration with a crust or plaque over top (16,18). They may spread to deeper tissues and become fluctuant. In some patients, spread occurs proximally along a lymphatic line in a sporotrichoid appearance (8,9,18,20). Retrospective reviews have found the fingers, hand, or wrist to be the most common site of infection (17,22). This is in keeping with common modes of exposure, and high-risk groups include individuals who either work with fish or handle aquariums. Other areas of presentation include the elbows, knees and feet, if contracted while swimming (7). The infection tends to restrict itself to superficial areas given its inability to grow at 37°C, thus, preferentially selecting areas of the body with cooler temperatures (9).

In the setting of nodular lymphangitis with a sporotrichoid appearance, *M marinum* should always be considered in the differential diagnosis. Differential diagnosis should include sporotrichoid lesions from the soil fungus, *Sporothrix schenckii*. The presentation of both *M marinum* and this fungus are similar, with proximal lymphatic spread; however, sporotrichosis typically causes axillary pain or lymphadenopathy, both of which are generally absent in *M marinum* infection (20). Culture and histology should also help distinguish *S schenckii* from *M marinum*. Other potential causative pathogens in the setting of a sporotrichoid march include *Nocardia* species, *Francisella tularensis*, *Bartonella henselae* and *Leishmania* species. Noninfectious causes, such as sarcoidosis, neoplastic tumours and foreign body reactions, may also be considered (16,22).

Other nontuberculous *Mycobacterium* species may also be considered as causative pathogens where a granulomatous cutaneous process is identified. Consideration may be given to infection caused by *Mycobacterium avium* complex, *M kansasii*, *Mycobacterium terrae* complex, *Mycobacterium haemophilum* (more often in immunosuppressed) and *Mycobacterium abscessus*. As discussed above, specimens for mycobacterial culture should be incubated at a lower temperature as well as 37°C, because this may aid in differentiating certain species. *M marinum*, *Mycobacterium chelonae* and *M haemophilum* will grow at lower temperatures (16,18). In assessing for potential exposure to *M marinum*, physicians should ask specifically about marine exposures including aquarium fish, as well as sea monkeys.

The treatment of *M marinum* infections has evolved through the decades from observation to surgery to conservative management with antibiotics (10,17). There is currently no specific algorithm of treatment for *M marinum* infection; however, guidelines have been published regarding treatment (8). Therapy includes antibiotics, with deeper infections requiring surgery (7). *M marinum* isolates are generally

susceptible to macrolides, trimethoprim sulfamethoxazole, rifampin, rifabutin and ethambutol (8). Minocycline and doxycycline are also therapeutic options, although sensitivity testing may demonstrate intermediate susceptibility (8,19). Some strains may be sensitive to ciprofloxacin, although monotherapy should be avoided due to the potential for resistance development (8,19). Of note, this organism is resistant to isoniazid and pyrazinamide and has intermediate susceptibility to streptomycin (8,19). Presently, no studies have shown an association with any specific antibiotic and more favourable outcomes. Although the data are limited, good clinical outcomes in the treatment of superficial cutaneous infections have been observed with dual therapy employing a combination of clarithromycin, ethambutol or rifampin. The guidelines from the American Thoracic Society and Infectious Diseases Society of America suggest that dual therapy consisting of clarithromycin and ethambutol, with the addition of rifampin for osteomyelitis, is a reasonable choice for therapy to optimize efficacy

and patient tolerability (8). Experts recommend therapy to continue four to eight weeks beyond the resolution of lesions (8). Monotherapy is usually discouraged for deeper infections, but may be sufficient for simple skin and soft tissue infections. In cases of superficial disease, a number of agents have been used successfully as monotherapy. Given limited disease without signs of deep involvement in the present case, clarithromycin monotherapy was used with a successful clinical outcome.

SUMMARY

The present case suggests *A. nyos* (also known as brine shrimp or sea monkeys) to be a source of *M. marinum* infection. As such, the present case demonstrates an unusual, and previously unreported, source of cutaneous *M. marinum* infection, although with a classic clinical presentation. Because sea monkeys are commonly kept as 'pets' in many households, physicians should be aware that they could be a potential source of *M. marinum* infection.

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