Case and Review

Tattoo-Associated Cutaneous *Mycobacterium mageritense* Infection: A Case Report and Brief Review of the Literature

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Keywords

Cutaneous · Infection · *Mycobacterium mageritense* · Nontuberculous mycobacteria · Tattoo

Abstract

There have been increasing reports of tattoo-associated mycobacterial infections in recent years, with a number of outbreaks documented worldwide. This has therefore become a public health concern. Nontuberculous mycobacteria (NTM) are capable of producing skin and soft tissue infections typically via inoculation during surgery, trauma, and cosmetic procedures. We present a case of tattoo-associated cutaneous infection caused by *Mycobacterium mageritense*, a rare species of rapidly growing NTM. A 25-year-old man developed a rash on his left lower leg 4 weeks after he underwent professional tattooing. A skin swab identified *M. mageritense* complex. Based on susceptibility testing, a course of oral ciprofloxacin and trimethoprim/sulfamethoxazole was initiated, with significant improvement observed after 5 weeks. We speculate that the mechanism of inoculation was a result of either the artist using nonsterile water to dilute black ink to gray or from use of contaminated prediluted gray ink. The Therapeutic Goods Administration does not have regulatory authority over the sterility of tattoo inks or practices in Australia. Instead, tattoo practices are regulated by local government jurisdictions. Because of the variability seen in clinical presentation and challenges associated with organism identification, a high index of suspicion is required to diagnose mycobacterial infections. Infection caused by NTM should be considered in the differential diagnosis of tattoo-associated dermatological complications, particularly in patients who have chronic lesions, negative bacterial cultures, and fail to respond to standard antibiotic therapy. Mandatory regulations for safe tattoo practices should be considered to prevent outbreaks and ensure public safety.

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Introduction

Complications resulting from tattoos are uncommon, but the incidence is rising due to the increased popularity of body art seen in recent years [1]. Although rare, nontuberculous mycobacteria are capable of producing skin and soft tissue infections typically via inoculation during surgery, trauma, tattooing, and other cosmetic procedures. There have been increasing reports of tattoo-associated mycobacterial infections with a number of outbreaks documented in the USA, United Kingdom, Germany, and France. This has therefore become a public health concern [2]. Rapidly growing nontuberculous mycobacteria including *Mycobacterium chelonae*, *Mycobacterium abscessus*, and *Mycobacterium fortuitum* account for the majority of tattoo-associated infections in both sporadic cases and outbreak settings [3–7]. Herein, we report a case of tattoo-associated cutaneous infection caused by a rare species of rapidly growing mycobacteria, *Mycobacterium mageritense*.

Case Report

A 25-year-old man presented for evaluation of an erythematous papulopustular rash of 2 months duration, localized within tattooed areas of the left lower leg. The skin eruption developed 4 weeks after he underwent tattooing by a professional tattoo artist in Townsville, Australia, and had not responded to treatment with topical corticosteroids. The patient had no complications with prior or subsequent tattoos. He reported no medical comorbidities and had no systemic symptoms. On examination, there were multiple scaling erythematous papules and pustules scattered within the tattooed areas of the left lower leg (shown in Fig. 1). The lesions were confined predominantly to areas of the skin tattooed with gray ink, sparing the black-ink portions of the tattoo. There was no associated regional lymphadenopathy.

A skin swab from a pustule was obtained and sent for typical and atypical bacterial and fungal culture. Acid-fast bacilli with features of mycobacteria species were grown at 2 weeks. At 4 weeks, *M. mageritense* complex was identified. Drug-susceptibility testing revealed sensitivity to ciprofloxacin, moxifloxacin, co-trimoxazole, and linezolid, and resistance to clarithromycin,

Fig. 1. Scaling erythematous papules and pustules coalescing into plaques on the left lower leg resulting from tattoo-inoculated *M. mageritense* infection. Lesions are confined predominantly to areas of the skin tattooed with gray ink.

Fig. 2. Histopathological examination. This section shows dermal scarring involving the superficial and mid dermis with neovascularization, and a mixed chronic and granulomatous inflammatory reaction. The epidermis appears focally attenuated with partial loss of the rete.

tobramycin, and amikacin. Punch biopsies were obtained for tissue culture and proven negative for infection. Histopathology findings were nonspecific, and showed dermal scarring and a mixed chronic and granulomatous inflammatory reaction (shown in Fig. 2).

Based on clinical history, histopathological findings, and culture results, a diagnosis of tattoo-associated cutaneous *M. mageritense* infection was made. After consultation with an infectious disease specialist, a 3-month course of oral ciprofloxacin (750 mg twice daily) and trimethoprim/sulfamethoxazole (160/800 mg twice daily) was initiated. Significant clinical improvement was observed after 5 weeks of treatment.

Discussion

In recent years, decorative tattoos have become increasingly more popular in Australia among both men and women [8]. Three large national studies in 1998, 2001–2002, and 2004–2005 have reported prevalences of 10% [9], 13% [10], and 15% [8], respectively, in Australians aged 14 years or older. Dermatological complications associated with tattoos are uncommon and predominantly include hypersensitivity reactions, acute and chronic infections, inflammatory dermatoses, localization of skin disorders to the tattoo, and neoplasms [1, 11, 12]. The authors from one study, in their series of 234 tattooed patients, estimated the prevalence of tattoo-associated dermatological complications to be 2.1% [1].

Nontuberculous mycobacteria encompass all mycobacterial species other than *Mycobacterium tuberculosis* and *Mycobacterium leprae*. They are ubiquitous in the environment and can be found in water, soil, animals, and plant matter. Tap water is the primary reservoir for human transmission. Nontuberculous mycobacteria can be found in large urban water distribution systems in Australia. As reported by one study which sampled approximately 220 sites across Brisbane, nontuberculous mycobacteria were grown from 40.21% of sites in summer and 82.05% of sites in winter [13]. Rapidly growing nontuberculous mycobacteria, despite their low pathogenicity in humans, can cause a wide range of clinical diseases including skin and soft tissue infections; respiratory, endocardial, meningeal, or bone infections; catheter infections; and disseminated disease [14]. Skin and soft tissue infections have varying clinical presentations including papules, pustules, nodules, ulcers, plaques, folliculitis, abscesses, cellulitis, and panniculitis [5, 7, 15]. Immunocompromized patients tend to present with disseminated cutaneous infection, while immunocompetent patients generally present with localized lesions on the extremities at sites of trauma, or previous surgical and cosmetic procedures [16].

M. mageritense, a recently identified rapidly growing nontuberculous mycobacterium, is a rare clinical pathogen that exhibits a wide spectrum of disease, predominantly skin and soft tissue infections, but also pulmonary infections, osteomyelitis, prosthetic valve

endocarditis, prosthetic joint infections, parotitis, and catheter-related blood stream infections [17–23]. A review of the literature identified only one other case of tattoo-associated *M. mageritense* infection, as summarized in Table 1 [15]. Our patient's presentation is very similar to the case described by Park et al. [15] with regard to morphology and onset of symptoms.

Tattoo-associated cutaneous nontuberculous mycobacterial infection has several etiologies, including the contamination of tattoo inks either during the manufacturing process or from dilution of ink with nonsterile tap water by tattoo artists, contamination of equipment responsible for the introduction of pigment, and inadequate hygienic practices [3–7, 24]. The purpose of diluting tattoo inks with water is to produce desired gradations of color. In the present case, and a significant number of previously reported cases of tattoo-associated nontuberculous mycobacterial infections, localization of lesions to gray tattoo pigment has been described. We therefore speculate that the mechanism of inoculation was likely a result of either the artist using nonsterile water to dilute black ink to gray or from the use of prediluted gray ink that was contaminated during the manufacturing process.

Intradermal introduction of nonsterile tattoo ink can pose a significant health risk and is therefore a public health concern [2]. Tattoo inks are not considered to be therapeutic goods, and as such, the Therapeutic Goods Administration does not have regulatory authority over tattoo safety nor does it specifically mandate sterility of tattoo inks or practices. Instead, the practice of tattooing in Australia is regulated by local government jurisdictions. The *Tattoo Industry Act 2013* outlines occupational licensing and regulatory framework for the Queensland tattoo industry, and the *Public Health (Infection Control for Personal Appearance Services) Act 2003* aims to minimize the risk of infection that may result from the provision of skin penetration services [25, 26]. The Queensland Government Infection Control Guidelines for Personal Appearance Services 2012 recommends that tattoo artists only use liquids which are free of contamination for ink dilution, such as treated drinking water or ethyl alcohol [27].

While biopsy with culture is the gold standard for primary species identification of nontuberculous mycobacteria, it often requires long incubation periods which may cause delays in patient care [28, 29]. New diagnostic techniques such as DNA probes, polymerase chain reaction assays, and matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS) can provide rapid and reproducible ways of identifying nontuberculous mycobacteria species within a few days from growth, although they do not provide antimicrobial susceptibility information [28, 29]. Matrix-assisted laser desorption ionization-time of flight mass spectrometry has emerged as a rapid and reliable tool that is increasingly being used for the identification of mycobacterial species. This technique allows for the identification of nontuberculous mycobacteria through unique spectral fingerprints produced by extracted proteins [28]. Viable organisms isolated from a culture plate are required, as well as a MALDI-TOF instrument with a validated database of mycobacterial spectra [29]. Due to the limited availability of databases, this system has yet to be utilized by many laboratories [29]. Furthermore, due to the paucity of evidence for the identification of minor nontuberculous mycobacteria such as *M. mageritense* by MALDI-TOF MS, the result must be corroborated by other techniques such as DNA sequencing of 16S ribosomal RNA and other gene regions [23]. Further data are needed to warrant the use of MALDI-TOF MS as a stand-alone method for the identification of *M. mageritense* [23].

In nontuberculous mycobacterial skin and soft tissue infections, prolonged treatment with combination therapy including at least 2 susceptible antimicrobials is recommended to minimize the risk of antibiotic resistance [30]. The current recommended duration of therapy for skin and soft tissue infections caused by rapidly growing mycobacteria is usually 4 months for mild disease and 6–12 months for severe disease [6, 30]. Macrolide antibiotics are considered

Table 1. Summary of cases describing tattoo-associated cutaneous *Mycobacterium mageritense* infection

First author	Location of cases	Location of tattoo parlor	Age in years, sex	Latency	Clinical appearance	Tattoo color	Postulated source of infection	Treatment	Outcome
Park et al. [15]	California, USA	Philippines	48, M	3 wk	Monomorphic erythematous papules and pustules coalescing into plaques, located on the shaded portions of the ink with sparing of the main outline of the tattoo	Black, gray	Not postulated	Minocycline, 100 mg BD, and moxifloxacin, 400 mg OD (3 mo)	Complete resolution after 3 mo of dual antibiotic therapy
Present case	Queensland, AUS	Townsville, AUS	25, M	4 wk	Scaling erythematous papules and pustules coalescing into plaques, localized to areas of gray tattoo pigment with sparing of the blank ink portions of the tattoo	Black, gray	Ink dilution with nonsterile water or use of contaminated prediluted gray ink	Ciprofloxacin, 750 mg BD, and trimethoprim/sulfamethoxazole, 160/800 mg BD (3 mo)	Significant clinical improvement after 5 wk of dual antibiotic therapy
USA, United States of America; M, male; wk, weeks; mg, milligrams; BD, twice daily; OD, once daily; mo, months; AUS, Australia.									

a standard treatment for patients with nontuberculous mycobacteria infections [30]. Clarithromycin is often included in combination therapy for tattoo-associated nontuberculous mycobacterial infections involving *M. chelonae*, *M. abscessus*, and *M. fortuitum* [6, 7]. However, *M. mageritense* is known to be resistant to macrolides due to the erythromycin ribosomal methylesterase gene, which confers resistance to macrolide antibiotics [17]. *M. mageritense* is generally susceptible or intermediate to amikacin, imipenem, cefoxitin, fluoroquinolones, and sulfonamides, but resistant to clarithromycin [17]. Antibiotic therapy, however, should always be guided by susceptibility testing [15].

Conclusion

To our knowledge, this is the first case of tattoo-associated cutaneous *M. mageritense* infection reported in Australia. Cutaneous infection with rapidly growing nontuberculous mycobacteria has emerged as a rare but increasingly prevalent complication of decorative tattooing worldwide. Because of the variability seen in clinical presentation, nonspecific histopathological features, and challenges associated with organism identification, a high index of suspicion is required to accurately and promptly diagnose mycobacterial infections. Infection caused by *M. mageritense* and other rapidly growing nontuberculous mycobacteria should be considered in the differential diagnosis of tattoo-associated dermatological complications, particularly in patients with chronic lesions who have negative routine bacterial cultures and fail to respond to standard antibiotic therapy. Consultation with infectious disease specialists is encouraged since treatment can be challenging and often requires multidrug regimens for extended periods of time. Mandatory regulations for safe tattoo practices should be considered in order to prevent outbreaks and ensure public safety.

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Statement of Ethics

Written informed consent was obtained from the patient for publication of this case report and accompanying images in accordance with the World Medical Association Declaration of Helsinki. Ethical approval was not required for this study in accordance with local/national guidelines.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Yolanka Lobo contributed to conception of the work, design of the work, acquisition and analysis of data, drafting the work, revising the work for important intellectual content, and final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Karyn Lun contributed to conception of the work, design of the work, acquisition and analysis of data, drafting the work, revising the work for important intellectual content, and final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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