ELSEVIER

Clinicopathologic Study of Satellite Lesions in Nontuberculous Mycobacterial Keratitis

Fung-Rong Hu,* Wei-Jen Huang* and Shiu-Feng Huang†

*Department of Ophthalmology and †Department of Pathology, National Taiwan University Hospital, Taipei, Taiwan

Abstract: Multifocal stromal infiltrates or "satellite lesions" have been considered a characteristic feature of fungal keratitis. We examined two patients with nontuberculous mycobacterial keratitis who clinically presented with satellite lesions. The keratitis consisted of multifocal stromal infiltrates with indistinct white and fluffy margins. Both patients received topical fortified amikacin therapy with poor response. Lamellar keratectomy or penetrating keratoplasty was performed, respectively, in the two patients because of progressive stromal thinning and enlarging satellite lesions. Histopathologically, the main lesions consisted of dense infiltration of inflammatory cells with numerous acid-fast bacilli, while the satellite lesions were composed chiefly of inflammatory cells with fewer mycobacteria. Besides fungal keratitis, nontuberculous mycobacterial keratitis should also be considered when satellite lesions are present. **Jpn J Ophthalmol 1998;42:115–118** © 1998 Japanese Ophthalmological Society

Key Words: Nontuberculous mycobacterial keratitis, satellite lesion.

Introduction

Since the first report by Turner and Stinson in 1965,[1] nontuberculous mycobacterial keratitis has become increasingly recognized recently. In most of the cases reported previously, delayed diagnosis and eventual surgical intervention was common, which may have been due to the variable clinical features and poor response to conventional antimicrobial agents.[1–19] The typical clinical picture of nontuberculous mycobacterial keratitis is a chronic, indolent corneal ulcer with white fluffy infiltrates. Satellite lesions, a well-known characteristic feature of fungal keratitis, have also been mentioned in some cases of nontuberculous mycobacterial keratitis.[8,16,18,20] However, there are few published reports regarding the clinical and histologic findings of satellite lesions in nontuberculous mycobacterial keratitis. We report the clinicopathologic manifestations in two patients with nontuberculous mycobacterial keratitis presenting with satellite lesions.

Received: February 24, 1997

Address correspondence and reprint requests to: Fung-Rong HU, MD, 7 Chung-Shan South Road, Department of Ophthalmology, National Taiwan University Hospital, Taipei, Taiwan

Case Reports

Case 1

A 25-year-old man sustained corneal trauma in his right eye from an iron foreign body in August 1990. He was treated by an ophthalmologist, and some topical eyedrops were administered after removal of the corneal foreign body. However, he continued to experience a foreign-body sensation, irritation, and redness intermittently in the following month during therapy with a topical steroid and 0.3% gentamicin solution. This patient was referred to our hospital for further evaluation and management of suspected fungal keratitis in September 1990. On ocular examination, the conjunctiva was congested. A 4 × 3.5 mm epithelial defect with deep, fluffy stromal infiltrates was noted over the paracentral cornea. Two 1 × 1-mm-sized satellite lesions confined to the anterior stroma were also present (Figure 1). Epithelium over the satellite lesions was intact. There was moderate anterior chamber reaction. No ophthalmoscopic abnormality could be recognized.

Corneal scrapings contained many inflammatory cells but no definite microorganism. Repeated scraping showed hyphae-like microorganisms. Antifungal agents including topical natamycin, miconazole, and

Jpn J Ophthalmol 42, 115–118 (1998)

Published by Elsevier Science Inc.

0021-5155/98/$19.00
PII S0021-5155(97)00117-2

Jpn J Ophthalmol
Vol 42: 115–118, 1998

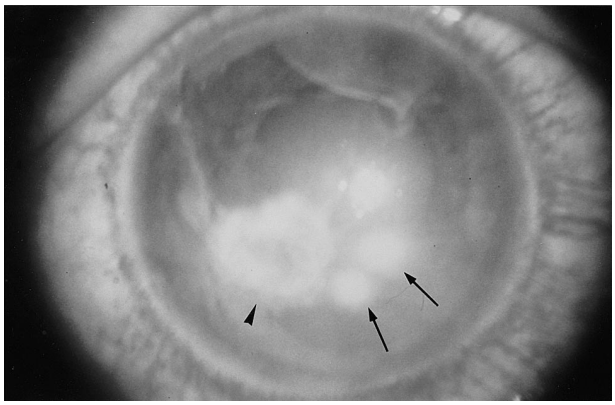

Figure 1. Case 1: Preoperative photograph showing corneal ulcer consisting of one main lesion (arrowhead) and two satellite lesions (arrow).

systemic ketoconazole were prescribed without noticeable clinical improvement. Culture of superficial corneal scrapings was negative, but repeated culture from deeper stomal infiltrates grew *Mycobacterium chelonae*. Topical amikacin (25 mg/mL) was then added to the initial medication. Infiltrates of the main lesion remained stationary, but the satellite lesions enlarged progressively despite fortified topical amikacin therapy. Lamellar keratectomy encompassing the main and the satellite lesions was performed 14 days after initiation of amikacin. During histopathological examination, the excised corneal tissue showed infiltration of polymorphonuclear cells and lymphocytes. No epitheloid granuloma was seen. Numerous acid-fast bacilli were detected in the main lesion, but only a few acid-fast bacteria could be recognized in the satellite lesions, although the inflammatory cell infiltrates were also dense.

After the lamellar keratectomy, topical amikacin was continued and gradually tapered in the following 2 months. No evidence of recurrence was noted during follow-up. One year after surgery, visual acuity was 20/30 in the right eye.

Case 2

A 24-year-old man was struck in his right eye by a metallic foreign body, which was removed 2 days later by an ophthalmologist. The corneal epithelial defect seemed to be healing satisfactorily on the next day. Two weeks later, a central corneal epithelial defect was noted, and topical steroid and gentamicin solution were given. The clinical condition fluctuated over the following 2 months. The keratitis was unresponsive to medical therapy, and this patient was subsequently referred to our hospital for suspected fungal keratitis in April 1993.

Slit-lamp examination disclosed marked congestion of the conjunctiva with copious mucopurulent discharge. A 5×3 mm ulceration with deep stromal infiltration was detected over the central cornea. The margin of the lesion was indistinct and feathery. In addition to the larger main lesion, there were three 0.5-mm-sized round satellite lesions confined to the superficial stroma (Figure 2A). The central cornea also showed diffuse microcystic edema. The anterior chamber reaction was marked with minimal hypopyon formation.

Corneal scrapings from the main lesion showed scattered acid-fast bacilli compatible with nontuberculous mycobacteria. Repeated cultures of corneal scrapings performed on 3 separate days were negative for growth. He received topical fortified amikacin (25 mg/mL) hourly for presumed nontuberculous mycobacterial keratitis based on the findings of smear. Despite topical amikacin therapy, corneal melting progressed in the main lesion. The infiltrates of the satellite lesions progressively enlarged in size and deepened (Figure 2B). Because of the progressive keratolysis and enlarging corneal satellite lesions, this patient underwent penetrating keratoplasty and intracameral amikacin irrigation after 1 week of amikacin treatment. The removed corneal button revealed dense infiltration of acute and chronic inflammatory cells over both main and satellite lesions with no epitheloid granuloma. An acid-fast stained section showed large aggregates of acid-fast slender rods over the main lesion (Figure 3) and fewer acid-fast bacteria in the satellite lesions (Figure 4). Culture from the ground corneal button grew *M. chelonae* 5 days later. Four months after surgery, the graft was clear without evidence of recurrent infection in the host or donor tissue. The visual acuity was 20/40 in the right eye.

Discussion

Nontuberculous mycobacteria have been referred to as "atypical" or "anonymous" because they have different characteristics from *M. tuberculosis*. Nontuberculous mycobacterial keratitis is an uncommon disease. In 1965, Turner and Stinsen reported the first case of a corneal involvement by *M. fortuitum*.[1] Since then, about 40 cases of keratitis due to nontuberculous mycobacteria have been reported in the literature. Most of them were caused by *M. fortuitum* and *M. chelonae*,[1–19] and a few cases were due to *M. gordonae*,[21] *M. avium-intracellulare*,[22] *M. marinum*,[23] and *M. flavescens*.[24]

In the reported cases of nontuberculous mycobacterial keratitis, infection occurred 2–5 months after corneal injuries or corneal surgical procedures, including corneal foreign body,[1–3,6,8,10,14,15] suture removal,[4,19]

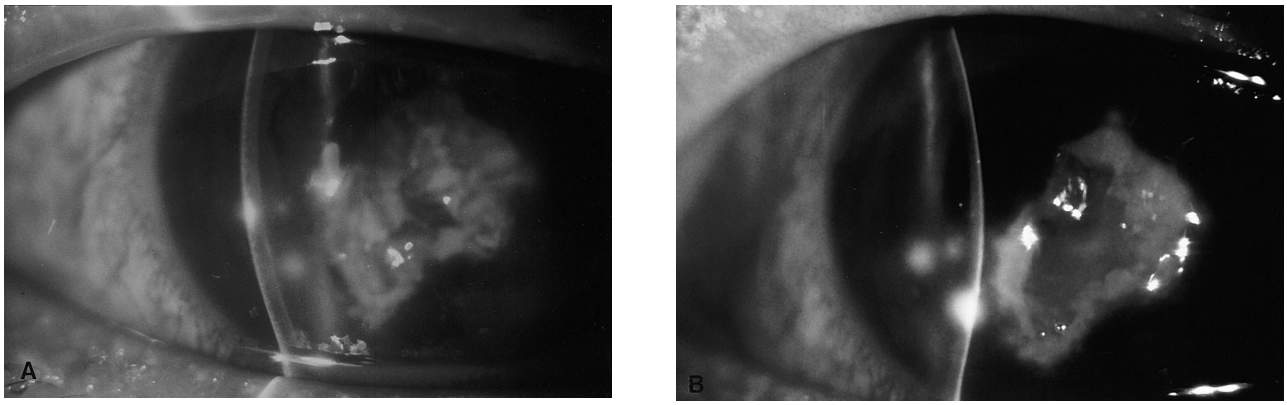

Figure 2. Case 2: (**A**) Initial picture showing necrotic main lesion with two small satellite lesions. Note the fluffy and indistinct margin of the lesions. (**B**) One week after amikacin therapy, the infiltrate of the satellite lesions became larger and deeper. Corneal melting was recognized in the main lesion.

radial keratotomy,[13] and penetrating keratoplasty.[15,19] Delayed diagnosis was a common feature, which may be due to the variable clinical manifestations and high false-negative rate of culture and smear. Frequently, initial cultures from superficial corneal scrapings failed to reveal the causative microorganism, and final diagnosis was established after histopathologic examination of corneal specimens from lamellar keratectomy or penetrating keratoplasty.[3,6,7,12,15] In case 1, initial culture and smear from superficial corneal scrapings were both negative; only culture obtained from the deeper stromal infiltrates supported growth of the pathogen. In case 2, repeated cultures of corneal scraping were all negative, and only the culture of the ground corneal button from penetrating keratoplasty disclosed the growth of *M. chelonae*. When nontuberculous mycobacterial infection is suspected, we think corneal biopsy is mandatory if repeated cultures of superficial corneal scrapings are negative.

The clinical picture of nontuberculous mycobacterial keratitis is very similar to fungal keratitis, which frequently has been the mistaken initial diagnosis for several reported cases of nontuberculous mycobacterial corneal ulcer,[1,4–7,12,13] including the present two cases in this study. Both diseases tend to be chronic and indolent. The corneal infiltrates in nontuberculous mycobacterial keratitis are white and fluffy with indistinct margins and radiating projections. Lazar observed four early cases and used the term *cracked windshield* to describe the corneal appearance.[8] Multifocal infiltrates or satellite lesions, a characteristic feature of fungal keratitis, also developed in our cases. In fungal keratitis, the microorganisms multiply by hyphae extension, with orientation parallel to the

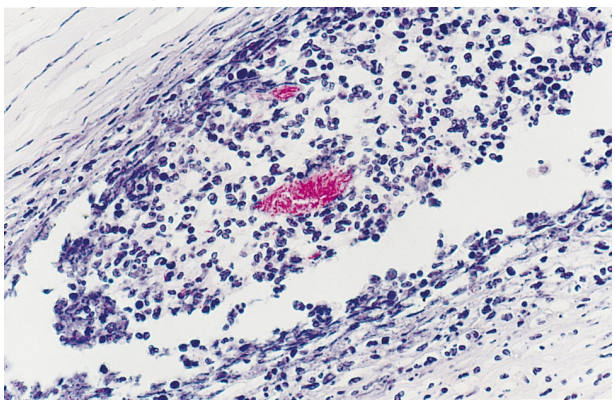

Figure 3. Case 2: Photomicroscopy of the main lesion revealed large aggregates of acid-fast bacilli among dense inflammatory infiltrates. Corneal stroma was necrotic (acid-fast stain, original magnification ×400).

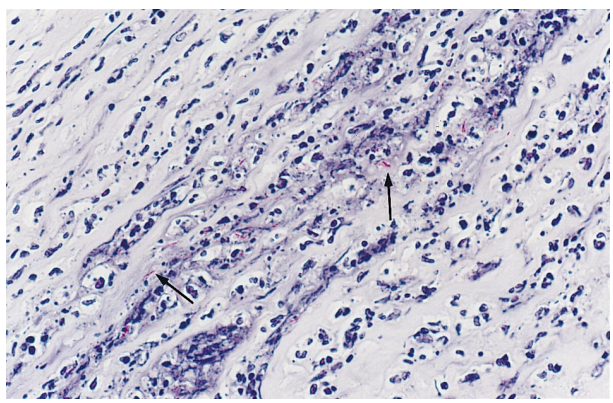

Figure 4. Case 2: Photomicroscopy of the satellite lesion revealed moderate acute and chronic inflammatory cell infiltrations with scattered acid-fast bacilli (arrow) (acid-fast stain, original magnification ×400).

Jpn J Ophthalmol
Vol 42: 115–118, 1998

corneal lamellae. Formation of satellite lesion in fungal keratitis is due to spreading of fungal hyphae and proliferation of pathogens in the new locus. The pathologic specimens of our cases demonstrated that the satellite lesion in nontuberculous mycobacterial keratitis is also due to spreading of the microorganisms, which hence incites the inflammatory response.

Paschal et al reported an animal model of *M. fortuitum* keratitis by corneal inoculation followed with subconjunctival steroid injection.[20] Satellite lesions were noted in six of eight corticosteroid-treated rabbits but none in the untreated animals. Their study demonstrated that corticosteroids played an important role in the development of satellite lesions in nontuberculous mycobacterial keratitis. The adverse effect of topical steroids on nontuberculous mycobacterial keratitis was noted in most of the reported cases including the present two cases. Dugal et al reported four cases of *M. fortuitum* keratitis.[15] Two cases developed multifocal stromal infiltrates, though not typical satellite lesions, after steroid treatment. Steroid therapy will suppress the granulomatous inflammation and facilitate the growth of microorganisms. The impaired self-defense and the presence of numerous pathogens will facilitate the spread of microorganisms and, thus, the formation of satellite lesions. We think that steroid usage and abundance of microorganisms are the most important factors contributing to the development of satellite lesions.

Nontuberculous mycobacterial keratitis is not very responsive to most conventional antibiotics, although newer drugs, such as ciprofloxacin, have been reported to have clinical effect.[25,26] Early diagnosis is important but is usually difficult. The absence of organisms in superficial corneal scrapings does not exclude the diagnosis of nontuberculous mycobacterial infection. Repeated cultures and smears from deeper lesions are recommended. Misdiagnosis of fungal origin is common, especially in the presence of satellite lesions. One should consider the possibility of nontuberculous mycobacterial keratitis in the differential diagnosis of corneal ulceration with satellite lesions. Early accurate diagnosis, the avoidance of steroid usage, and using effective antibiotics combined with surgical debridement may prevent the formation of satellite lesions in nontuberculous mycobacterial keratitis and result in more successful treatment.

References

1. Turner L, Stinson I. *Mycobcterium fortuitum* as a cause of corneal ulcer. Am J Ophthalmol 1965;60:329–31.
2. Turner L. Atypical mycobacterial infections in ophthalmology. Trans Am Ophthalmol 1970;68:667–729.
3. Levenson DS, Harrison CH. *Mycobacterium fortuitum* corneal ulcer. Arch Ophthalmol 1966;75:189–91.
4. Wunch SE, Boyle GL, Leopold IH, Littman ML. *Mycobacterium fortuitum* infection of corneal graft. Arch Ophthalmol 1969;82:602–7.
5. Willis WE, Laibson PR. Intractable *Mycobacterium fortuitum* corneal ulcer in man. Am J Ophthalmol 1971;71:500–4.
6. Lauring LM, Wergeland FL, Sack GE. Anonymous *Mycobacterium* keratitis. Am J Ophthalmol 1969;67:130–3.
7. Zimmerman LE, Turner L, McTigue JW. *Mycobacterium fortuitum* infection of the cornea: A report of two cases. Arch Ophthalmol 1969;82:596–601.
8. Lazar M, Nemet P, Bracha R, Campus A. *Mycobacterium fortuitum* keratitis. Am J Ophthalmol 1974;78:530–2.
9. Gangadharam PRJ, Lanier JD, Jones DE. Keratitis due to *Mycobacterium chelonae*. Tubercle 1978;59:55–60.
10. Meisler DM, Friedlaender MH, Okumoto M. *Mycobacterium chelonae* keratitis. Am J Ophthalmol 1982;94:398–401.
11. Mirate DJ, Hull DS, Steel JH, Carter MJ. *Mycobacterium chelonae* keratitis: a case report. Br J Ophthalmol 1983;67:324–6.
12. Newman PE, Goodman RA, Waring GO III, et al. A cluster of cases of *Mycobacterium chelonae* keratitis associated with outpatient office procedures. Am J Ophthalmol 1984;97:344–8.
13. Robin JB, Beatty RF, Dunn S, et al. *Mycobacterium chelonae* keratitis after radial keratotomy. Am J Ophthalmol 1986;102: 72–9.
14. Moore MB, Newton C, Kaufman HE. Chronic keratitis caused by *Mycobacterium gordonae*. Am J Ophthalmol 1986;102: 516–21.
15. Dugel PU, Holland GN, Brown HH. *Mycobacterium fortuitum* keratitis. Am J Ophthalmol 1988;105:661–9.
16. Sossi N, Feldman RM, Feldman ST, Frueh BE, Pharmd GM, Davis C. *Mycobacterium gordonae* keratitis after penetrating keratoplasty. Arch Ophthalmol 1991;109:1064–5.
17. McClellan KH, Bernard PJ, Robinson LP, Meades KV, Hylward GW, Billson FA. Atypical mycobacterial keratitis. Aust N Z J Ophthalmol 1989;17:103–5.
18. Dalovisio JR, Pankey GA. In vitro susceptibility of *Mycobacterium fortuitum* and *Mycobacterium chelonae* to amikacin. J Infect Dis 1978;137:318–21.
19. Hu FR. Extensive lamellar keratectomy for treatment of nontuberculous mycobacterial keratitis. Am J Ophthalmol 1995; 120:47–54.
20. Paschal JF, Holland GN, Sison RF, et al. *Mycobacterium fortuitum* keratitis, clinicopathologic correlates and corticosteroid effects in an animal model. Cornea 1992;11:493–9.
21. Moore MB, Newton C, Kaufman HE. Chronic keratitis caused by *Mycobacterium gordonae*. Am J Ophthalmol 1986;102:516–21.
22. Knapp A, Sterm GA, Hood CI. *Mycobacterium avium-intracellulare* corneal ulcer. Cornea 1987;6:175–80.
23. Schonherr U, Naumann GOH, Lang GK, Bialasiewicz AA. Sclerokeratitis caused by *Mycobacterium marinum*. Am J Ophthalmol 1989;108:607–8.
24. Bulling RH, Lanier JD, Font RL. Nontuberculous mycobacterial keratitis: report of two cases and review of the literature. Arch Ophthalmol 1992;110:519–24.
25. Wallace RJ Jr, Bedsole G, Sumter G, et al. Activities of ciprofloxacin and ofloxacin against rapidly growing mycobacteria with demonstration of acquired resistance following single-drug therapy. Antimicrob Agents Chemother 1990;34:65–70.
26. Hwang DG, Biswell R. Ciprofloxacin therapy of *Mycobacterium chelonae* keratitis. Am J Ophthalmol 1993;115:114–5.