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CASE REPORT

Three Cases of Postoperative Septic Arthritis Caused by *Mycobacterium conceptionense* in the Shoulder Joints of Immunocompetent Patients

Keun Hwa Lee,[a,b] Sang Taek Heo,[c] Sung-Wook Choi,[d] Da Hee Park,[a,b] Young Ree Kim,[b,e] Seung Jin Yoo[c]

Department of Microbiology and Immunology, Jeju National University School of Medicine, Jeju, South Korea[a]; The Environmental Health Center, Jeju National University School of Medicine, Jeju, South Korea[b]; Department of Internal Medicine, Jeju National University School of Medicine, Jeju, South Korea[c]; Orthopedic Surgery, Jeju National University School of Medicine, Jeju, South Korea[d]; Laboratory Medicine, Jeju National University School of Medicine, Jeju, South Korea[e]

***Mycobacterium conceptionense* is a species member of *Mycobacterium fortuitum* complex, a potential pathogen of increasing clinical importance among opportunistic infections. This species causes a wide spectrum of cutaneous and extracutaneous diseases. In this report, we describe three patients who underwent shoulder surgery with postoperative joint infection by *M. conceptionense*.**

CASE REPORTS

Case 1 was a 72-year-old man admitted due to painful swelling of his right shoulder of 5 days' duration. One month prior to this admission, he had undergone arthroscopic rotator cuff repair for a rotator cuff tear in the right shoulder. He had tested seronegative for human immunodeficiency virus (HIV) before operation. A magnetic resonance image (MRI) of the right shoulder indicated fluid accumulation around a thickened synovium with prominent contrast enhancement. Incision and debridement of this infectious lesion were performed, which yielded turbid exudative fluid. He was started on cefazolin. On the 5th day of admission, Gram-positive rods and acid-fast bacilli (AFB) were identified from the intraoperative culture samples. At that time, arthroscopic debridement was carried out because the wound on the right shoulder worsened despite the initial drainage and treatment with intravenous antibiotics. The intraoperative sample from arthroscopic debridement returned positive for AFB staining and nontuberculous mycobacteria (NTM) on PCR.

On the 7th day after the second operation, the mycobacterial culture of discharge and tissue yielded NTM, which was identified as *Mycobacterium fortuitum* complex species according to conventional culture methods. The patient was started with parenteral cefoxitin (1 g every 8 h), amikacin (500 mg every 24 h), and oral clarithromycin (500 mg every 12 h).

The *rpoB* gene was sequenced and analyzed for further identification of NTM species. The isolate was identified as *Mycobacterium conceptionense*. Antimicrobial susceptibility testing of the isolate revealed the MICs of antibiotics as shown in Table 1. The MIC for clarithromycin changed from 2 μg/ml on the 3rd day to 8 μg/ml on the 7th day of incubation, showing that this strain had inducible resistance to clarithromycin. Based on the final susceptibility outcome, the antibiotic regimen was changed to 100 mg oral doxycycline every 12 h and 400 mg oral moxifloxacin every 24 h. After oral medication for 12 weeks, the patient was observed to be without relapse or complications.

Case 2. Case 2 was a 71-year-old HIV-seronegative woman who presented to the outpatient clinic with a painful swelling of the right shoulder of 5 days' duration. She had undergone reverse total shoulder arthroplasty due to right rotator arthropathy 1 month prior to presentation. Physical examination revealed swelling, local heat, tenderness, and serous discharge over the previous operative incision site. Incision and debridement were performed. On the 7th day, culture of intraoperative discharge and tissue collected at the operation yielded Gram-positive rods and acid-fast bacilli (AFB), and we identified NTM by PCR assay.

The patient received intravenous amikacin (200 mg every 12 h), imipenem (500 mg every 12 h), and oral clarithromycin (500 mg every 12 h). After 4 weeks, according to the result of antibiotic susceptibility testing (Table 1), the antibiotic regimen was changed to oral clarithromycin (500 mg every 12 h) and moxifloxacin (400 mg every 24 h) for maintenance treatment for 20 weeks. She has been followed for up to 1 year without any complication and relapse.

Case 3. Case 3 was A 79-year-old woman who presented to our outpatient clinic with a painful swelling of her right shoulder of 7 days' duration. She had undergone an arthroscopic rotator cuff repair for right rotator cuff tear 2 months prior to the visit. She also was seronegative for HIV and was not immunocompromised. Physical examination revealed swelling, local heat, and tenderness, and a pulled-out screw was found on MRI. Arthroscopic debridement was performed, and pathological examination returned as suspicious caseating granulomas with negative acid-fast stain. On the 7th day of admission, culture of intraoperative samples yielded Gram-positive rods, and PCR assay revealed NTM.

The patient received intravenous amikacin (200 mg every 12 h), cefoxitin (3 g every 6 h), and oral clarithromycin (500 mg every 12 h). After 4 weeks, the susceptibility test result became available (Table 1), and the antibiotic regimen was changed to oral doxycycline (100 mg every 12 h) and ciprofloxacin (400 mg every 24 h) for 4 weeks. The lesion improved slowly during maintenance treatment.

The incidence of NTM infection has increased in both coun-

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Address correspondence to Sang Taek Heo, neosangtaek@naver.com.

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TABLE 1 Profiles of antimicrobial susceptibility tests of the three cases in this study[a]

Antibiotic(s)	Case 1		Case 2		Case 3	
	MIC (μg/ml)	Susceptibility	MIC (μg/ml)	Susceptibility	MIC (μg/ml)	Susceptibility
Amikacin	4	S	≤1	S	≤1	S
Cefoxitin	64	I	16	S	32	I
Ciprofloxacin	1	S	2	I	0.5	S
Clarithromycin	2–8	IR	≤0.5	S	≤0.5	S
Doxycyline	≤0.25	S	≤0.25	S	≤0.25	S
Imipenem	8	I	2	S	8	I
Moxifloxacin	0.25	S	0.5	S	0.25	S
TMP/SMX	32/608	R	16/304	R	8/152	R
Linezolid	32	R	16	I	16	I

[a] Antimicrobial susceptibility was tested by the broth microdilution method and used Clinical and Laboratory Standards Institute guideline M24-A2 for the rapidly growing NTM (15). IR, inducible resistant; S, susceptible; I, intermediate; R, resistant; TMP/SMX, trimethoprim-sulfamethoxazole.

tries where NTM is endemic and countries without NTM endemicity, especially as a consequence of the HIV epidemic. The incidence of cutaneous NTM infection was 1.3 per 100,000 person-years (1). With respect to NTM, skin and soft tissue infection (SSTI) is often associated with surgical procedure and trauma, and extrapulmonary manifestations tend to disseminate in hosts with immunosuppression, such as those under steroid and immunosuppressive treatments and those with malignant neoplasm or AIDS. *M. conceptionense*, a species member of *M. fortuitum* complex, is a rapidly growing mycobacterium (RGM) found in the environment, such as water and soil (2). The first isolation of this organism was reported from the wound samples from a patient with posttraumatic osteitis (3). *M. conceptionense* as an opportunistic pathogen causing SSTI is shown in Table 2 (3–6). This is the first report of surgical site infections (SSIs) in the shoulder joint caused by *M. conceptionense* in 3 immunocompetent patients. Three strains isolated from each patient were identified using partial *rpoB* DNA sequences. Partial *rpoB* DNA sequences containing the Rif^r region, which is related to rifampin resistance, have been used to delineate *Mycobacterium* and non-*Mycobacterium* species (7). Therefore, we performed *rpoB* analysis using *rpoB* primers (MF, 5′CGACCACTTCGGCAACCG3′; MR, 5′TCGATCGGGC ACATCCGG3′) as well as phylogenetic analysis based on the results of *rpoB* sequencing (6). The *rpoB* DNA sequences showed 99 to 100% sequence homology with the known *rpoB* sequence of *M. conceptionense*, a species member of *Mycobacterium fortuitum* complex. This result suggests that these three cases have been caused by the same species.

We were not able to identify the source of contamination. Early onset of prosthetic joint NTM infection is considered to result from intraoperative contamination with mycobacteria from tap water or tap water-derived fluids used during prosthesis implantation or in cleaning surgical instruments (8). However, intraoperative contamination could not explain the present cases. These three cases of shoulder SSI by *M. conceptionense* occurred within 6 months, and there have been no other SSI cases associated with NTM in recent years. Following the recognition of these three cases, the infection control team at our institution performed an epidemiological investigation to identify the source of infection. The same surgeon had performed all index operations in the three patients in the same operating room. These three cases were operated on by one surgeon in the same operation room on different occasions. Environmental studies were carried out on all potential sources of NTM contamination. Ten samples, including samples of operation table padding, poles of the instrument cage, the camera case, light cable, irrigation line channel and surface, camera line, and arthroscopy, were obtained by cotton ball smear for surfaces and irrigation for channels from the operation room (room no. A7). Due to difficulties in NTM identification, we extracted DNA for PCR by using DNA extraction buffer containing resin (Bioseum, Seoul, South Korea). We performed real-time PCR by using the the Real-QTM MTB and NTM kit (Bioseum, Seoul, South Korea) with a 2× PCR mixture and internal control (IC) primer-probe mixture. The results of NTM PCR, however, were all negative. Some NTM infections associated with bathing water have been reported (9, 10). Two of the patients had visited differ-

TABLE 2 Summary of cases of skin and soft tissue infection caused by *Mycobaterium conceptionense*

Case no.	Age (yr)	Sex[a]	Trauma history	Type of infection[b]	Site(s) of infections	History of water contact	Outcome	Reference
1	31	F	Open right tibial fracture	SSI	Right tibia	River	Not reported	3
2	43	F	No	Subcutaneous abscess	Left ankle	Denied	Improved	4
3	58	F	Breast reconstruction	Breast implant infection	Left breast	None	Unremarkable results	5
4	50	F	Facial fat grafting	Subcutaneous abscess	Both cheeks	None	Recovered	6
5	72	M	Shoulder operation	SSI	Right shoulder	Public bath	Recovered	This study
6	71	F	Shoulder operation	SSI (prosthetic joint)	Right shoulder	Public bath	Recovered (retained prosthesis)	This study
7	79	F	Shoulder operation	SSI	Right shoulder	Denied	Recovered	This study

[a] F, female; M, male.
[b] SSI, surgical site infection.

ent public bathhouses after operation. Upon the conclusion of epidemiologic investigation, no environmental source was confirmed to be associated with the *M. conceptionense* infections. Nevertheless, direct inoculation by *M. conceptionense* in a public bath during the postoperative period is a possible source for postoperative infection.

Data regarding diagnosis and management of NTM SSTI are limited or conflicting, and additional research is necessary. Although the American Thoracic Society (ATS) has guidelines for the diagnosis and management of NTM infections (11), the diagnosis and treatment regimens for bone and joint infections, especially those of postoperative joint infection, are not clear. The ATS guideline recommended a macrolide-based regimen for all NTM infections. The isolates from this study were 100% susceptible to doxycycline, amikacin, and moxifloxacin. In one of our cases, the empirical therapy had included clarithromycin-based combination therapy, but the NTM was subsequently found to have inducible resistance to clarithromycin (12, 13). Clarithromycin was previously first recommended in many cases, whereas current knowledge about *erm* gene inducibility reported resistance to this drug (12, 14). Following the antimicrobial susceptibility test results, the patient was treated with doxycycline. This showed the importance in the culture and antibiotic susceptibility test of the organism in NTM infections. Indeed, this report provides limited data for treatment of these infections; however, it may support the selection of antimicrobial agents when NTM-related SSTI is suspected in our region.

The patient in case 2 improved with debridement and retention of the prosthesis. In a case series on RGM joint infections, Albert et al. (8) retained the prosthetic joints in 3 out of 8 patients with RGM joint infections. Early suspicion and detection of causative agents, such as RGM, was critical in achieving recovery without removal of implants. In certain circumstances, surgical debridement is also an important component of successful therapy (11). In our cases, incision and debridement were performed with early, appropriate antimicrobial agents, which all resulted in complete response. All of our patients were cured without any recurrence of infection after 2 to 7 months of medical treatment.

To the best of our knowledge, these three cases represent the first report of shoulder joint SSIs caused by *M. conceptionense*. This study demonstrated that *M. conceptionense* is a potential pathogen of postoperative opportunistic infection in orthopedic surgery. Even though appropriate aseptic techniques are important in operation, early detection and appropriate antibiotics can decrease the need for removal of the implanted instrument and increase the healing rate of SSTIs caused by RGM.

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