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Case report

Septic arthritis and osteomyelitis due to *Roseomonas*; Case report and review of soft tissue, joint and bone infection

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ABSTRACT

Roseomonas gilardii rarely causes infection in humans. We report that a patient with underlying rheumatoid arthritis and diabetes developed wrist septic arthritis and osteomyelitis due to *Roseomonas* after steroid joint injection. After antibiotic and surgical treatment, the condition of the patient improved. We reviewed previously reported cases of soft tissue, joint and bone infection related to *Roseomonas* to understand the characteristics of joint and bone infection of *Roseomonas*.

Introduction

Roseomonas gilardii rarely causes infection in humans, and most *Roseomonas* infections manifest as central catheter infections in immunocompromised hosts, such as those with malignancies [1].

Here, we report a patient who developed septic arthritis and osteomyelitis, with underlying rheumatoid arthritis and diabetes, after steroid joint injection. After antibiotic treatment and operation, he was successfully treated and improved. We also reviewed previously reported cases of soft tissue, bone and joint infections related to *Roseomonas*.

Case presentation

A 57-year-old Korean male presented with painful swelling of his left wrist for 2 weeks. He had fever and chills for 1 week. His past medical history was significant for rheumatoid arthritis, diabetes, hypertension and hyperlipidemia. He received a steroid injection in his left wrist 1 month prior to his persistent wrist swelling. His medications included methotrexate, leflunomide, folic acid, meloxicam, metformin/linagliptin, amlodipine, and rosuvastatin. On physical exam, there was tenderness, swelling, redness and increased warmth on his wrist. He also showed tenderness and swelling without any redness or heat on his right ankle, which was related to his rheumatoid arthritis. His body temperature was noted at 38 °C.

Laboratory findings revealed a white blood count of 8.4×10^9/L with 74 % neutrophils (reference values 3.92–9.8 $\times$ 10^9/L), hemoglobin levels of 120 g/L (reference values 132–162 g/L) and platelet count of 218 $\times$ 10^9/L (reference values 165–415 $\times$ 10^9/L). His erythrocyte sedimentation rate (ESR) and C-reactive protein levels were 95 mm/h (reference values: 0–20 mm/h) and 13.8 mg/L (reference values 0.2–3.0 mg/L), respectively. Two separate blood cultures were negative. Magnetic resonance imaging (MRI) of the left wrist showed joint effusion with synovial thickening and enhancement at the radiocarpal and midcarpal joints (Fig. 1). There was bone marrow edema and enhancement with cortical erosion at the distal radius and triquetrum.

Based on his clinical symptoms and imaging findings, he was diagnosed with osteomyelitis and septic arthritis in settings of underlying rheumatoid arthritis and treated with intravenous cefazolin (2.0 g every 8 h per day). On the third day after admission, fever continued, and his symptoms were persistent. Surgical debridement and decompression of his wrist was performed. Drainage and synovectomy were performed. Bone and synovial biopsy and culture were performed during the operation. On day 7 after admission, bone culture and synovial culture showed pink-colored gram-negative bacilli. Antibiotics were changed to intravenous ceftazidime (2.0 g every 8 h per day) to cover probable *Pseudomonas aeruginosa* infection. After treatment with ceftazidime, his fever subsided, and the patient's symptoms gradually improved. On the 11th day, *Roseomonas gilardii* was isolated from bone and synovial cultures. The organism identification was performed with a Vitek instrument (bioMérieux, Nürtingen, Germany). Because antibiotic susceptibility for *Roseomonas gilardii* based on Clinical and Laboratory Standards Institute (CLSI) guidelines was not established, our laboratory department and outside laboratory department were not able to

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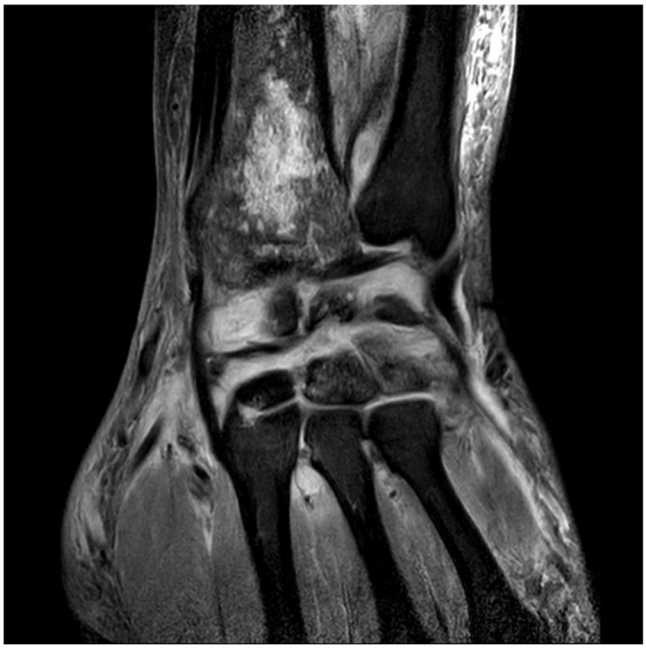

Fig. 1. Coronal T2-weighted scan of the left wrist showing joint effusion with synovial thickening and enhancement of the radiocarpal and midcarpal joints. Bone marrow edema and enhancement was noted at the distal radius, and joint space narrowing was observed in the radiocarpal joint.

determine antibiotic susceptibility tests. Therefore, the results of the antibiotic susceptibility test were not reported. In the meantime, the patient improved gradually. On day 21 after admission, the patient was discharged, and oral ciprofloxacin (750 mg twice per day) was prescribed for 6 weeks. The patient was treated with a total of 8 weeks of antibiotics, intravenous ceftazidime and then oral ciprofloxacin. ESR and C-reactive protein levels were normalized, and the patient improved almost completely without residual pain or mobility deficit.

Discussion

Roseomonas gilardii is a slow glowing, gram-negative coccobacilli that belongs to the genus *Roseomonas*. Roseomonas comprises more than 20 species, including *Roseomonas gilardii, Roseomonas mucosa, Roseomonas cervicalis* , and *Roseomonas terrae* [2,3]. Although the natural reservoir of *Roseomonas* is not yet known, *Roseomonas* can be isolated from environmental sources, such as air, water, and soil.

Roseomonas mucosa is the causative organism in most cases related to *Roseomonas* infection. Most cases due to *Roseomonas* are related to central line infection leading to bacteremia in immunocompromised hosts [1]. Less than twenty cases of soft tissue, bone and joint infection related to *Roseomonas* infection have been reported to date, and *Roseomonas gilardii* was isolated in only several cases. Table 1 shows the clinical characteristics of soft tissue, joint and bone infections related to *Roseomonas*. Among thirteen cases including our case, seven cases presented with soft tissue infections, such as cellulitis, and six cases presented with bone and joint infections. *Roseomonas mucosa* was isolated in most cases, with *Roseomonas gilardii* being the second most commonly isolated species. Specific species were not described in some cases. Since infection mostly occurred following previous events, such as surgery, animal bite, or injection, the acquisition of infection was mostly likely to occur through direct inoculation or from contiguous spread rather than hematogenous spread. The common risk factors for soft tissue, joint or bone infection for other bacteria are known to include previous surgery, rheumatoid arthritis, old age, concomitant skin infection and diabetes,

Table 1
Characteristics of soft tissue, joint and bone infection related to *Roseomonas*.

Age/sex	Pathogen	Clinical presentation	Preceding event, underlying diseases	Surgical intervention	Treatment, antimicrobials *	Outcome
54 y/F [3]	*R. mucosa*	Spinal epidural abscess	Instrumented posterior lumbar fusion	Drainage	Vancomycin for 24 days, and switched to Meropenem for total 8 weeks	Improved
40 y/M [5]	*R. mucosa*	Septic arthritis	Rheumatoid arthritis, infliximab	None	Ceftriaxone, and switched to oral ciprofloxacin for 8 weeks	Improved
8 m/M [6]	*R. mucosa*	Soft tissue infection	Tethered cord with dermal tract	Removal surgery	Vancomycin and cefotaxime **	Improved
27 y/M [6]	*R. mucosa*	Cellulitis	Nil	None	Amoxicillin-clavulanate **	Improved
75 y/M [6]	*R. mucosa*	Cellulitis	Diabetes	None	Amoxicillin-clavulanate **	Improved
46 y/F [6]	*R. mucosa*	Cellulitis	Nil	None	Ciprofloxacin **	Improved
55 y/M [8][8]	*R*	Vertebral osteomyelitis	Chronic lung disease, lung lobectomy. steroid use,	CT-guided percutaneous aspiration, open biopsy	Ceftriaxone, and changed to oral ofloxacin for 6 weeks	Died
74 y/M [10]	*R*	Infectious spondylitis	Vertebroplasty, laminectomy	Total corpectomy	Ceftazidime for 6 weeks	Improved
34 y/M [11]	*R* (genome species 5)	Wrist purpuric lesion	Sprain of right ankle	None	Penicillin for 3 days, and changed to oral ampicillin	Improved
91 y/M [11]	*R. gilardii*	Infectious knee bursitis	Degenerative arthritis	None	Cefoxitin and cephalexin **	Improved
42 y/F [12]	*R. gilardii*	Cellulitis, bacteremia	Suspicious spider bite, hepatitis C hypertension	None	Cefepime for 14 days	Improved
16 y/F [13]	*R. gilardii*	Septic arthritis	Reconstructive surgery following sports-related injury	Open lavage	Ceftriaxone and oral doxycycline, and then oral doxycycline monotherapy for total 8 weeks	Improved
56 y/M (our case)	*R. gilardii*	Septic arthritis, osteomyelitis, wrist	Rheumatoid arthritis, diabetes, steroid injection	Debridement, drainage, synovectomy	Ceftazidime for 2 weeks and switched to oral ciprofloxacin for 6 weeks	Improved

R: Roseomonas , *y:* years, m: months.
*: All antimicrobials were intravenously administered unless specifically described as being orally administered.
**: The mode of administration of antimicrobials was not revealed.

and most cases listed in Table 1 had similar risk factors. Rheumatoid arthritis itself is a well-known risk factor for septic arthritis. Inflammatory joint disease could be a predisposing factor for bacterial colonization, and the use of steroids and immunosuppressive agents could work as another predisposing factor for septic arthritis [4]. Similar to the patient described in the case report by Sispas et al. [5], our patient had rheumatoid arthritis as well as other risk factors for septic arthritis, such as diabetes, steroid use, disease-modifying antirheumatic drug use, and intraarticular injection. Compared to the patient Sispas's case, our patient showed a more aggressive course, including septic arthritis progressing to osteomyelitis. Therefore, surgery was needed in our patient.

There have been several papers showing antibiotic susceptibility for *Roseomonas*. *Roseomonas* species were mostly susceptible to imipenem, were susceptible to ciprofloxacin in over half, and were resistant to cephalosporins, including cefotaxime, ceftriaxone, and ceftazidime [2,6,7]. According to the literature, ceftazidime might not be a good choice for our patient. However, when we treated our patient with ceftazidime while assuming *Pseudomonas* infection at first, the patient improved. Because our patient showed improvement with the introduction of ceftazidime, we were reluctant to change the antibiotics. After the patient was discharged, the antibiotic was changed to oral ciprofloxacin. Ciprofloxacin showed a good response for *Roseomonas* in previous case reports and case series [1,5,6]. Interestingly, meropenem was tried in only one case of soft tissue, bone and joint infection (Table 1). Although imipenem or meropenem seemed to be the most effective agent for *Roseomonas* [2,6,7], ampicillin, various generations of cephalosporins and ciprofloxacin were tried and seemed effective in cases of soft tissue, joint and bone infection related to *Roseomonas* (Table 1). In those cases, antibiotics were empirically chosen initially for targeting *Staphylococcus* or *Streptococcus*, which are the most common pathogens of those infections. *Roseomonas* is a slow-growing pathogen. While awaiting the final report of the organism, patients' condition might be improved due to empirical use of those antibiotics.

Most cases of soft tissue, joint and bone infection, including our case, have shown favorable outcomes after the use of antibiotics and with or without surgery. Only one patient who had vertebral osteomyelitis underlying chronic lung disease died [8]. However, this patient seemed to die of respiratory failure rather than osteomyelitis. In a case series of catheter-related infections caused by *Roseomonas*, most patients improved successfully with antibiotic use [1]. In some cases, patients improved with only catheter removal without any antibiotic treatment. In several cases listed in Table 1, surgery was needed, especially in joint and bone infections, since removing infectious foci was necessary due to pus or abscess formation. In our patient, surgery was performed to treat septic arthritis and osteomyelitis. Surgical debridement, decompression, drainage and synovectomy were performed. Considering the reported insusceptibility of *Roseomonas* to cephalosporin, the profound improvement of this patient might have been due to aggressive surgical intervention and full debridement. Therefore, in cases of osteomyelitis and septic arthritis related to *Roseomonas,* addition to antibiotics, surgical debridement is important to achieving cure.

Our paper had some limitations. To identify the organism, we used a Vitek instrument, not the 16S rRNA method, which is regarded as the most precise test for identifying organisms. With Vitek, there could be possible misinterpretation of *Roseomonas mucosa* as *Roseomonas gilardii* [9]. We did not obtain susceptibility results for antibiotics, which are important information for treating septic arthritis. However, despite these limitations, our paper still has some clinical significance. Reports of bone and joint infections related to *Roseomonas* are still rare. Through our paper and review of previous case reports, the characteristics related to soft tissue, bone and joint infection of *Roseomonas* were described.

Conclusion

Most soft tissue, joint and bone infections related to *Roseomonas* seemed to have direct or adjacent spread rather than hematogenous spread. Treatment for septic arthritis or osteomyelitis related to *Roseomonas* often requires a combination of surgery and antibiotics. With surgery and appropriate use of antibiotics, the prognosis is usually good.

CRediT authorship contribution statement

Minyoung Her: Data collection, data analysis, Writing – review & editing.

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Ethical approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Consent

Written informed consent was obtained from the patient for publication of this case reports and accompanying images.

Conflict of Interest

The author has no potential conflicts of interest to disclose.

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