

## Case Report

# Infective Spondylitis with Epidural Abscess Formation Caused by *Roseomonas mucosa*: A Case Report and Literature Review

Zong-Han Lin <sup>1</sup>, Yu-Chang Lu <sup>1</sup> and Kuan-Sheng Wu <sup>2,3</sup>

<sup>1</sup>Department of Medical Education and Research, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan

<sup>2</sup>Division of Infectious Diseases, Department of Internal Medicine, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan

<sup>3</sup>School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan

Correspondence should be addressed to Kuan-Sheng Wu; [genesis@pie.com.tw](mailto:genesis@pie.com.tw)

Received 2 February 2023; Revised 28 April 2023; Accepted 14 May 2023; Published 22 May 2023

Academic Editor: Piyush Baidara

Copyright © 2023 Zong-Han Lin et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Roseomonas mucosa* (*R. mucosa*) is a pink-pigmented, aerobic, nonfermentative, slow-growing Gram-negative coccus typically isolated from the natural environment, human skin, and hospital environment. This pathogen, in most circumstances, leads to infections in immunocompromised hosts, but it may sometimes invade immunocompetent individuals. Bacteraemia is the most common form of infection caused by *R. mucosa*. In contrast, only two case reports have described *R. mucosa*-related epidural abscess formation and infective spondylitis. In this case report, we shared the history and treatment experience of a 76-year-old female who was diagnosed with infective spondylitis and epidural abscess caused by *R. mucosa*. She received a local transdermal injection into the lower back to relieve her back pain two months before symptom onset, which was considered to be associated with this infection episode. After admission to the hospital, neurosurgeons performed emergent decompression and debridement. She was treated with intravenous ceftriaxone for four weeks, followed by oral ciprofloxacin for another eight weeks. The patient recovered well without any sequelae and had no relapse of infection at least six months after the end of treatment. In addition to the case report, we reviewed the literature for reported cases caused by *R. mucosa*. Our experience suggests that clinicians should include *R. mucosa* as one of the possible healthcare-associated pathogens among individuals who have undergone transdermal procedures. We believe that this article will help clinicians better recognize *R. mucosa* infection.

## 1. Introduction

The *Roseomonas* species was first documented in 1993 [1], and in 2003, *R. mucosa* was established as a separate species from *Roseomonas gilardii* because of its distinct genotype and phenotype [2]. This Gram-negative coccus has been isolated from the natural environment [3–6], human skin [7], and hospital environment [8]. It is generally believed that people infected with *R. mucosa* are primarily immunocompromised [9] or have underlying diseases [10]. However, a few reports have revealed that *R. mucosa* also infects immunocompetent individuals and might lead to severe infections [11].

Epidural abscess is a severe central nervous system infection [12] and may lead to fever, back pain, neurological deficits, impaired motor function, paralysis, and even death

[13]. *R. mucosa* is an infrequent cause of epidural abscess formation. In this case report, we present the disease course of a female diagnosed with infective spondylitis and epidural abscess formation caused by *R. mucosa*. In addition, we reviewed the literature and listed all published articles on *R. mucosa* infection.

## 2. Case Presentation

**2.1. Clinical Course.** A 76-year-old female with independent daily activity presented with progressive low back pain for five days and fever for three days. She had a medical history of type 2 diabetes mellitus under reasonable medical control and left breast cancer, for which she had undergone surgical resection five years prior.

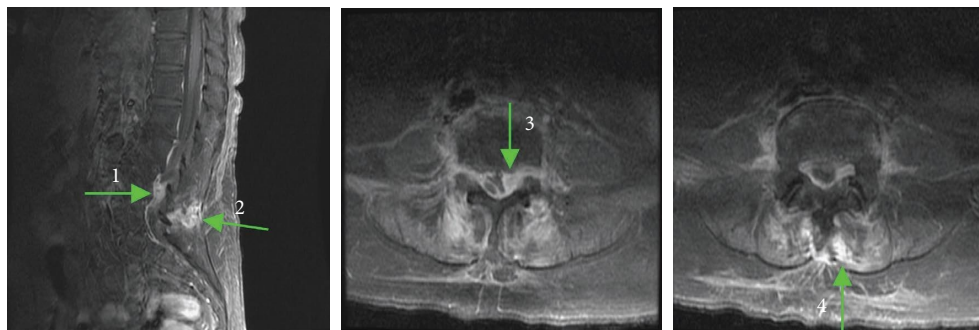


FIGURE 1: T1 sagittal and axial contrast-enhanced MRI obtained prior to surgery, showing focal, small, lobulated fluid collection at the posterior epidural space of L4-L5 (arrows 1 and 3), with adjacent soft-tissue swelling at the epidural space and posterior column of the L4-L5 level (arrows 2 and 4).

Two years prior, she was diagnosed with spinal retrolisthesis over L2-L5. In addition, an orthopaedist noted a collapsed disc at L3-L4 with bilateral nerve root compression. She had been experiencing intermittent low back pain and numbness over the left leg since that time and sought rehabilitation, taking painkillers as needed. Orthopaedics did not suggest surgical intervention in consideration of her severe osteoporosis and independent daily activity status. To relieve the low back pain, the patient sought various treatment modalities over the past two years. Two months before admission, she underwent a so-called “nerve block” procedure by receiving a local transdermal injection into her lower back. One month prior, she received radiofrequency coagulation pain therapy at a local hospital.

Her low back pain became more severe and unbearable five days before this admission. She fell at home three days prior and was admitted to a local hospital. Her body temperature was 39.0°C upon admission, with otherwise typical vital signs. Because of the severe painful disability, she could no longer stand and laid in bed all day. She was also put on a Foley catheter due to difficulty in urination. Under the suspicion of infective spondylitis, contrast L-spine magnetic resonance imaging (MRI) was performed and revealed an L3-L4 collapsed disc with nerve compression, which was not significantly different from previous findings. Having persistent fever and progressive low back pain, she was transferred to Kaohsiung Veterans General Hospital (KVGH), a tertiary teaching hospital, for further management.

Upon admission to KVGH, her vital signs were as follows: blood pressure 132/63 mmHg, pulse rate 74/min, respiratory rate 17/min, body temperature 38.4°C, and oxygen saturation 97%. On physical examination, her consciousness was clear, and there was a marked tender point over her lower back. The muscle power over the bilateral lower limbs was symmetrically decreased (grade 2 out of 5), while the muscle power over the bilateral upper limbs was intact. A bilateral straight leg raise test was positive, and the deep tendon reflex over the bilateral lower limbs was normal. Laboratory data reported leukocytosis, elevated erythrocyte sedimentation rate and C-reactive protein (15.38 mg/dl). Urine analysis showed pyuria, and urine culture yielded no pathogen. Under a high suspicion of infective spondylitis

with/without epidural abscess formation, cefepime and vancomycin were given as empirical antibiotics and an MRI was repeated on hospital Day 3. The images showed a focal, small, lobulated fluid collection at the posterior epidural space of L4-L5, with adjacent soft tissue swelling at the epidural space and posterior column of the L4-L5 level. Infective arthritis over the L4-L5 facet joint with adjacent epidural abscess formation leading to severe spinal stenosis at the L4-L5 level was concluded by the radiologist (Figure 1).

Emergent partial laminectomy of L3-L4 and internal decompression of L4-L5 was therefore conducted for debridement and decompression of the lesions. Some dirty fluid and granulation tissue collected during the surgery later yielded *R. mucosa*, which was identified by matrix-assisted laser desorption/ionization time of flight mass spectrometry (MALDI-TOF MS). Both fungal and mycobacterial cultures of the lesions were negative. An antimicrobial sensitivity test of *R. mucosa* was conducted by the E-test method and showed susceptibility to imipenem (0.5 µg/ml), ceftriaxone (1.5 µg/ml), amikacin (0.5 µg/ml), and ciprofloxacin (0.125 µg/ml). The pathological report described a bony tissue with acute and chronic inflammatory cell infiltration, bone necrosis, and focal granulation tissue, which is compatible with osteomyelitis.

After the spinal surgery, there was a notable improvement in the patient’s muscle strength. We utilized the Medical Research Council scale to assess the patient’s muscle power, which scores muscle strength from 0 to 5, with 0 indicating no contraction, 1 indicating trace contraction, 2 indicating active movement with gravity eliminated, 3 indicating active movement against gravity, 4 indicating active movement against resistance, and 5 indicating normal power. The patient’s muscle power in both lower extremities increased from grade 2 to 4 within two days following the surgery. However, during a follow-up MRI, an abscess measuring 1.5 cm in diameter was discovered at the L3-L4 level. In addition, an early stage of infective spondylodiscitis was noted at L4-L5 (Figure 2). Sonography-guided aspiration of the abscess was attempted but failed due to the small size of the lesion. We treated the patient with intravenous ceftriaxone 2 gm q12h for four weeks during the hospital course.

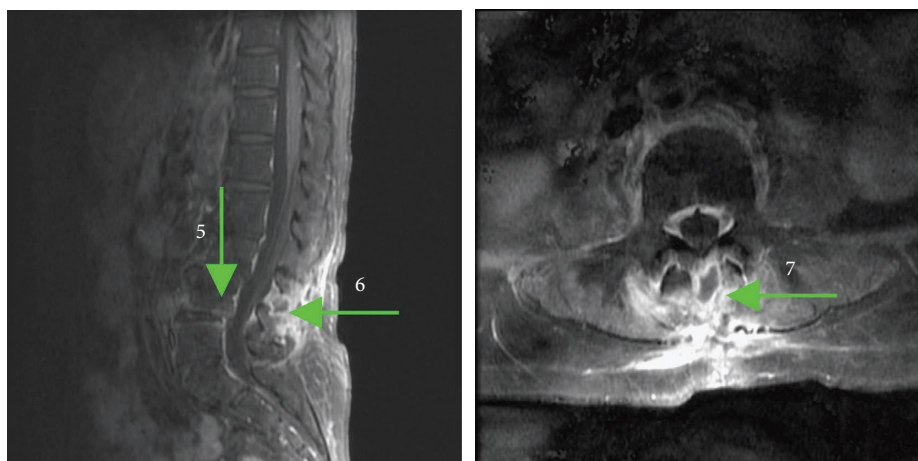


FIGURE 2: T1 sagittal and axial water-suppression contrast-enhanced MRI obtained approximately 1 month after surgery, showing early stage of infective spondylodiscitis between L4 and L5 (arrow 5) and Bastrup's disease between L3 and L4 with secondary abscess transformation (arrows 6 and 7).

Upon discharge from the hospital, her muscle power was grade 4 over the bilateral lower limbs. She could walk under the assistance of a four-foot walker but could not stand up by herself. The patient received another two months of oral antibiotics of ciprofloxacin 500 mg PO q12 h at the outpatient department. She recovered three months after the infection. Her muscle power in both lower limbs was graded as 5. She was able to walk with the assistance of a four-foot walker and could stand up independently. Although she still experienced some soreness in her left leg, there was no mention of any low back pain. There was no relapse of infection at least six months after the end of treatment.

**2.2. Laboratory Method.** The laboratory of KVGH inoculated the epidural abscess specimen onto blood agar, eosin methylene blue (EMB) agar, chocolate agar, Columbia C.N.A. agar, and thioglycolate broth. The following day, pink colonies were observed on EMB agar. After subsequent subculture and identification using MALDI-TOF MS, the colonies were identified as *Roseomonas mucosa*. Turbidity was also observed in the thioglycolate broth the following day, and subsequent subculture and identification yielded the same result of *Roseomonas mucosa*.

The KVGH laboratory routinely uses VITEK MS MALDI-TOF (BioMérieux, France) to identify bacterial species. The process for identifying bacteria using MALDI-TOF MS is as follows. First, a toothpick is used to pick up a colony from the agar plate and spread it evenly onto the center of a sample plate to form a thin bacterial film. Then, 1  $\mu$ l of VITEK MS-CHCA matrix solution is pipetted on the bacterial film, allowed to dry and then proceeded for identification. The strain of *Roseomonas mucosa* was identified using MALDI-TOF MS three times, with consistent results indicating a single bacterium and a high confidence value of 99.9.

The KVGH laboratory routinely uses the VITEK 2 system (BioMérieux, France) for antibiotic susceptibility testing. However, in the case of this *Roseomonas mucosa*, VITEK 2 system failed to generate the antibiotic

susceptibility testing result. Therefore, the E-test method was used instead, with the following procedure: first, 1-2 colonies were picked up from the agar using a sterile cotton swab and suspended in tryptic soy broth adjusted to McFarland No. 0.5 turbidity. Then, the swab was used to streak the Mueller-Hinton agar in three directions and allowed to dry for 2-3 minutes. The E-test strip was then carefully placed on the agar surface and incubated in a non-CO<sub>2</sub> 35°C  $\pm$  2°C incubator for 16-20 hours before interpreting. Antimicrobial susceptibility was interpreted according to the latest Clinical and Laboratory Standards Institute Guideline (M100-S 31).

### 3. Discussion

In the past, it was generally believed that *R. mucosa* is not highly pathogenic to immunocompetent populations. A systematic review [9] suggests that *R. mucosa* infections occur more frequently in immunocompromised patients or patients with severe comorbidities, including dialysis [14, 15], cancer [16, 17], HIV [18], and autoimmune disease [10]. In addition, the placement of catheter should be considered a risk factor [19, 20], and the assessment of whether to remove the relevant catheter after infection is considered an essential part of the treatment [21]. However, there is a growing body of the literature reporting that *R. mucosa* can potentially cause severe infections in immunocompetent patients [11, 22]. The most common infection caused by *R. mucosa* is bacteraemia. Other types of infections, although uncommon, have been reported sporadically (Table 1). We searched PubMed using the keyword combinations “*Roseomonas*,” “*Roseomonas mucosa*,” “epidural abscess,” and “infective spondylitis.” Only one case report described an epidural abscess due to *R. mucosa* infection [27]; another article reported a male with infective spondylitis caused by *R. mucosa* infection [11]. To the best of our knowledge, this article is the second reported case of infective spondylitis and epidural abscess caused by *R. mucosa* in the literature.

TABLE 1: Summary of reported infection cases caused by *Roseomonas mucosa* in the literature.

Reference	Age/sex	Infection	Underlying disease/risk factors	Identification	Drug resistance	Treatment	Outcome
Dé et al., 2004 [23]	21/F	Bacteraemia	Leukaemia	16S rRNA gene sequencing	n.d.	Removed CVC IV LFX → oral LFX + AMC IV IPM + VCM	Resolved
Dé et al., 2004 [23]	65/M	Bacteraemia	Lymphoma	16S rRNA gene sequencing	n.d.	Various antibiotics	Resolved
Dé et al., 2004 [23]	54/M	Bacteraemia	Leukaemia	16S rRNA gene sequencing	n.d.	IPM + VCM → FEP + VCM	Resolved
Christakis et al., 2006 [16]	39/M	Bacteraemia	Acute myelogenous leukaemia with neutropenic state	Identified as <i>Roseomonas</i> sp. by RapidID NF PLUS	R: CAZ, AZT, CTX, T'ZP, TCC, and TMP-SMX S: CFX, GM, TM, IPM, MEM, LFX, gatifloxacin, TE, AMK, FEP, and C	AMK + T'ZP for 10 Ds	Resolved
				Misidentified as Methylobacterium			
				mesophilicum by RapidID NF PLUS			
Elshibly et al., 2005 [24]	42/M	Bacteraemia	Diffuse large B-cell non-Hodgkin's lymphoma	Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: ABPC, AZT, CTX, CAZ, CXM, CFX, AMC, MEM, T'ZP, TMP, and IPM S: AMK, colomycin, GM, NET, and TM	T'ZP + GM → TEC + T'ZP + GM	Resolved
				16S rRNA gene sequencing			
				16S rRNA gene sequencing			
Sipsas et al., 2006 [25]	40/M	Septic arthritis	Rheumatoid arthritis receiving infliximab therapy	16S rRNA gene sequencing	R: benzylpenicillin, T'ZP, FOX, CRO, and CAZ S: CM, IPM, TE, DO, CFX, AMK, and GM R: ABPC, CEZ, CAZ, CRO, T'ZP, and TMP-SMX S: AMK, CFX, GM, IPM, LFX, MEM, and TM	D 1-3: IV CRO D 4-60: oral CFX	Resolved
				16S rRNA gene sequencing			
Bard et al., 2010 [26]	18/M	Bacteraemia	Multiple episodes of urinary tract infection and bacteraemia	16S rRNA gene sequencing	VCM + CRO → CFX for 10 Ds		Resolved
				Misidentified as Ochrobactrum anthropi and Acinetobacter lwofii by the VITEK 2 automated system			
				Misidentified as Methylobacterium mesophilicum by the API 20 NE system			
Boyd et al., 2012 [18]	19/M	Peritonitis	HIV + ESRD with PD	Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: T'ZP, CAZ, and TMP-SMX S: AMK, CRO, CFX, LFX, GM, IPM, MEM, and FEP	D 1-14: IP/IV CAZ + VCM D 14-35: IP CFX + GM + VCM D 35-49: IP CRO	PD failed; long-term haemodialysis commenced

TABLE 1: Continued.

Reference	Age/sex	Infection	Underlying disease/risk factors	Identification	Drug resistance	Treatment	Outcome
Maraki et al., 2013 [27]	54/F	Epidural abscess	Instrumented posterior lumbar interbody fusion	Misidentified as <i>R. gilardii</i> by the VITEK 2 automated system Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: beta-lactams (except CTX), FO, and colistin S: carbapenems, aminoglycosides, fluoroquinolones, TEs, TGC, C, MNO, and TMP-SMX	Surgical debridement D 1–24: IV VCM + oral rifampin D 25–81: MEM	Resolved
Al-Anazi et al., 2013 [28]	41/F	Bacteraemia	T-lymphoblastic lymphoma	Identified as <i>Roseomonas</i> by the VITEK 2 and the Microseq 500 16S rDNA bacterial identification kit Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: PIP, TZP, and all cephalosporins S: IPM, GM, AMK, and CFX	Removed CVC D 1–4: IV TZP D 4–14: IV IPM + AMK CFX	Resolved
Michon et al., 2014 [17]	3/n.d.	Bacteraemia	B-lineage acute lymphoblastic leukaemia	16S rRNA gene sequencing	R: TZP and IPM S: AMK	D 1–4: TZP D 4–7: IPM + AMK D 7–14: oral CFM	Resolved
Matsukuma et al., 2014 [14]	61/M	Peritonitis	Diabetic nephropathy and receiving PD for ESRD	16S rRNA gene sequencing	R: cephalosporins, including CAZ S: GM, CFX and MEM	D 1–3: IP CEZ + AMK D 4–6: IP CAZ D 7–28: IP CFX	Resolved, changed to haemodialysis
Kim et al., 2015 [11]	74/M	Infective spondylitis with bacteraemia	Vertebroplasty for compression fractures and laminectomy for spinal stenosis	Misidentified as <i>R. gilardii</i> by the VITEK 2 automated system Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: CFX, GM, and PIP S: carbapenems, CAZ, TIC, and TM	D 1–7: IV CEZ D 8–15: CAZ 1 month later: received total corpectomy + IV CAZ for 6 weeks	Resolved
Kim et al., 2016 [29]	84/F	Bacteraemia	Common bile duct obstruction	Misidentified as <i>R. gilardii</i> by the VITEK 2 automated system Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: ABPC and CAZ S: aminoglycosides, carbapenems, fluoroquinolones, and CTX	CTX + MET	Resolved
Kim et al., 2016 [29]	17/M	Bacteraemia	Acute myeloid leukaemia	Misidentified as <i>R. gilardii</i> by the VITEK 2 automated system Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: ABPC and CAZ S: aminoglycosides, carbapenems, fluoroquinolones, and CTX	CAZ + aminoglycoside → VCM + carbapenem	Resolved

TABLE 1: Continued.

Reference	Age/sex	Infection	Underlying disease/risk factors	Identification	Drug resistance	Treatment	Outcome
Bhende et al., 2017 [30]	74/M	Endogenous endophthalmitis	DM	16S rRNA gene sequencing	n.d.	D 1: intravitreal injection of CAZ + oral CTX + topical moxifloxacin + TM D 2: intravitreal injection of VCM + CAZ Received vitreous surgery + intravitreal CAZ Postoperation: oral CFX + moxifloxacin + TM drops for 5 Ds	Resolved
Abu Choudhury et al., 2017 [19]	53/M	Bacteraemia	Peripheral intravenous catheter insertion	Illumina Nextera XT and sequenced via the Illumina HiSeq 2000	n.d.	Cephalosporin	No systemic infection
Diesendorf et al., 2017 [31]	n.d.	Acute pulpitis	n.d.	MALDI-TOF mass spectrometry	R: ABPC, ABPC/SBT, PIP, TZP CEZ, CXM, CAZ, and FO S: CRO, IPM, MEM, GM, TM, AMK CFX, TMP-SMX, TE, TGC, and polymyxin B R: PIP, AZT, and CAZ	n.d.	n.d.
Kimura et al., 2018 [32]	9/M	Bacteraemia	Febrile neutropenia caused by chemotherapy for cerebellar medulloblastoma	16S rDNA sequencing	S: carbapenems, aminoglycosides, MNO, fluoroquinolones, and TMP-SMX	MEM	Resolved
Shao et al., 2019 [10]	44/F	Infective endocarditis	Systemic lupus erythematosus	Misidentified as <i>R. gillardii</i> by the VITEK 2 automated system Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	R: TZP, ABPC, CAZ, FEP, and colistin S: AMK, GM, LFX, CFX, IPM, and MEM	D 4-7: VCM + TZP D 8-11: TZP + LFX D 12-25: MEM + AMK	Resolved
Beucler et al., 2020 [33]	27/M	Peritonitis	VPS ventricular catheter for congenital hydrocephalus	MALDI-TOF mass spectrometry	R: TIC, TZP, CAZ, and FO S: IPM, MEM, GM, AMK, and CFX	Removal of the shunt D 1-9: CTX + linezolid	Resolved
Waris et al., 2021 [22]	17/M	Meningitis	Left temporal craniotomy for open fenestration of an arachnoid cyst	Misidentified as <i>R. gillardii</i> by the VITEK 2 automated system Identified as <i>R. mucosa</i> by 16S rRNA gene sequencing	S: LFX and MEM	D 1-2: IV MEM D 2-8: oral LFX D 10-12: IV MEM + VCM D 12-47: IV MEM	Resolved
Roy et al., 2021 [15]	65/F	Peritonitis	PD for ESRD	MALDI-TOF mass spectrometry	R: cephalosporin S: GM	Removed the PD catheter IP GM for 3 weeks	Resolved

TABLE 1: Continued.

Reference	Age/sex	Infection	Underlying disease/risk factors	Identification	Drug resistance	Treatment	Outcome
Spindel et al., 2022 [34]	30/M	Pyogenic hepatic abscess with cardiac tamponade	Daily tobacco and marijuana smoking	MALDI-TOF mass spectrometry	S: CRO and CFX	Emergent pericardiocentesis + hepatic and pericardial drains for 12 days D 1–5: TZP + MET D 5–40: CRO + MET	Resolved Metastatic hepatoid carcinoma noted 1 year later
Our case	76/F	Infective spondylitis with epidural abscess	Nerve block with local anaesthesia and radiofrequency coagulation in the lumbar spine	MALDI-TOF mass spectrometry	S: IPM, CRO, AMK, and CFX	Partial laminectomy + debridement D 1–7: FEP + VCM D 5: Debridement D 8–39: CRO D 39–99: CFX	Resolved

ABPC: ampicillin; AMC: amoxicillin-clavulanic acid; AMK: amikacin; AZT: aztreonam; C: chloramphenicol; CAZ: ceftazidime; CEZ: cefazolin; CFM: cefixime; CM: clindamycin; CRO: ceftriaxone; CFX: ciprofloxacin; CTX: cefotaxime; CXM: cefuroxime; D: day; DM: diabetes mellitus; DO: doxycycline; ESRD: end-stage renal disease; FEP: cefepime; FO: fosfomycin; FOX: ceftiofur; GM: gentamicin; IP: intraperitoneal; IPM: imipenem; IV: intravenous; LFX: levofloxacin; MEM: meropenem; MET: meropenem; MNO: minocycline; n.d.: not described; NET: netilmicin; PD: peritoneal dialysis; PIP: piperacillin; R: resistant; *R. mucosa*: *Roseomonas mucosa*; *R. gilardii*: *Roseomonas gilardii*; S: susceptible; SBT: sulbactam; TCC: ticarcillin-clavulanic acid; TEC: teicoplanin; TE: tetracycline; TGC: tigecycline; TIC: ticarcillin; TM: tobramycin; TMP-SMX: trimethoprim-sulfamethoxazole; TZP: piperacillin-tazobactam; VCM: vancomycin.

According to previous reports, *R. mucosa* is usually resistant to penicillins and cephalosporins and susceptible to carbapenems, tetracyclines, fluoroquinolones, and aminoglycosides [9, 35]. Our drug susceptibility tests of the *R. mucosa* isolate were similar to the literature. We treated the patient with intravenous ceftriaxone for four weeks, followed by oral ciprofloxacin for another eight weeks. The outcome was good, and there was no relapse of infection at least six months after the end of treatment.

*R. mucosa* is an easily misidentified species. A previous study [36] compared the identification ability of three routine laboratory bacterial identification methods for *R. mucosa*, including VITEK 2, MALDI-TOF MS, and 16S rRNA gene sequencing. The VITEK 2 system could misidentify the isolate as *Rhizobium radiobacter*, *Sphingomonas paucimobilis*, or *R. gilardii* [10, 27]. In comparison, MALDI-TOF MS and 16S rRNA gene sequencing had a more reliable identification ability. Generally speaking, 16S rRNA sequencing is often considered a superior method to MALDI-TOF MS for bacterial identification, as it provides greater taxonomic resolution at the species level. However, MALDI-TOF MS can also provide accurate identification of bacteria by comparing the mass-to-charge ratio and the mass spectra obtained by measuring the time of the bacteria proteins, which have been laser ionized, flight to the detector with those in a reference database [37]. The main reason for using MALDI-TOF in this current report is that it is the routine method in the KVGH laboratory and is most relevant to clinical practice. After all, 16S rRNA sequencing is mostly used for research purposes rather than clinical applications. In addition, MALDI-TOF is relatively inexpensive, has a higher accessibility, and can provide results within a few hours.

After compiling much of the literature on the subject, we have summarized the valuable lessons learned from this case and our treatment advice for similar cases. First, according to previous reports, *R. mucosa* is present in human skin [7] and medical settings [8]. A previous report [27] described that invasive interventions might cause skeletal muscle infections caused by the *Roseomonas* species. Our patient underwent several medical procedures before the onset of infection, including nerve block with local lidocaine injection and radiofrequency coagulation. We suspected that this infection episode was associated with one of the medical procedures, especially nerve block injection. Therefore, we suggest that among individuals who have healthcare-associated infections, especially those who have undergone transdermal procedures, clinicians should include *R. mucosa* as one of the possible pathogens [8]. Second, to identify the type of microorganism infected, we recommend using MALDI-TOF MS or 16S rRNA gene sequencing to avoid misidentifying strains. Finally, for the treatment, we recommend that once the location of the infection is identified, treatment should prioritize the removal of the source of the infection. Besides, since the antibiotics recommended by the Infectious Diseases Society of America for the prevention of postsurgical skin and soft tissue infections are usually not effective against *R. mucosa* [38], we recommend the use of carbapenems, tetracycline,

fluoroquinolone, or aminoglycosides when *R. mucosa* infection is identified, as *R. mucosa* is usually sensitive to these antibiotics.

There are two major limitations to this report. The first limitation is related to the method of bacterial identification utilized. Instead of using the gold standard of 16S rRNA sequencing, we relied on the clinically common MALDI-TOF MS method. While MALDI-TOF MS is commonly used in clinical settings and provides rapid results, it may not provide the same level of taxonomic resolution as 16S rRNA sequencing. The second limitation is that although we have reviewed most of the literature on the diseases related to *R. mucosa*, we only encountered one actual case, and our clinical experience with this species is still insufficient.

In conclusion, although rare, *R. mucosa* can cause epidural abscess formation and infective spondylitis in immunocompetent hosts. Since *R. mucosa* has fewer antibiotic choices, clinicians should arrange surgical removal or drainage as soon as possible once abscess formation occurs. In addition, *R. mucosa* should be considered a pathogen associated with medical procedures.

## Data Availability

The health record data used to support the findings of this case report are restricted to ensure patient privacy. Specific health record data have already been included within the article in a manner that does not compromise patient confidentiality.

## Ethical Approval

The Institutional Review Board of Kaohsiung Veterans General Hospital approved the study protocol (KSVGH22-CT6-02).

## Consent

The informed consent was waived due to the retrospective nature of this report and minimal risks to the participant.

## Conflicts of Interest

Kuan-Sheng Wu has received grants from Kaohsiung Veterans General Hospital to conduct this study.

## Authors' Contributions

Zong-Han Lin and Yu-Chang Lu contributed equally to this article.

## Acknowledgments

This work was supported by the Kaohsiung Veterans General Hospital: KSVGH112-075.

## References

- [1] J. D. Rihs, D. J. Brenner, R. E. Weaver, A. G. Steigerwalt, D. G. Hollis, and V. L. Yu, "Roseomonas, a new genus associated with bacteremia and other human infections,"



- Journal of Clinical Microbiology*, vol. 31, no. 12, pp. 3275–3283, 1993.
- [2] X. Y. Han, A. S. Pham, J. J. Tarrand, K. V. Rolston, L. O. Helsel, and P. N. Levett, “Bacteriologic characterization of 36 strains of *Roseomonas* species and proposal of *Roseomonas mucosa* sp. nov. and *Roseomonas gilardii* subsp. *rosea* subsp. nov.,” *American Journal of Clinical Pathology*, vol. 120, no. 2, pp. 256–264, 2003.
  - [3] V. Gallego, C. Sánchez-Porro, M. T. García, and A. Ventosa, “*Roseomonas aquatica* sp. nov., isolated from drinking water,” *International Journal of Systematic and Evolutionary Microbiology*, vol. 56, no. 10, pp. 2291–2295, 2006.
  - [4] Y. Q. Zhang, L. Y. Yu, D. Wang et al., “*Roseomonas vinacea* sp. nov., a Gram-negative coccobacillus isolated from a soil sample,” *International Journal of Systematic and Evolutionary Microbiology*, vol. 58, no. 9, pp. 2070–2074, 2008.
  - [5] L. L. Zhao, Y. Deng, Y. Sun, H. Y. Liu, L. Y. Yu, and Y. Q. Zhang, “*Roseomonas vastitatis* sp. nov. isolated from Badain Jaran desert in China,” *International Journal of Systematic and Evolutionary Microbiology*, vol. 70, no. 2, pp. 1186–1191, 2020.
  - [6] E. J. Chung, H. S. Yoon, K. H. Kim, C. O. Jeon, and Y. R. Chung, “*Roseomonas oryzaicola* sp. nov., isolated from the rhizosphere of rice (*Oryza sativa* L.),” *International Journal of Systematic and Evolutionary Microbiology*, vol. 65, no. Pt\_12, pp. 4839–4844, 2015.
  - [7] S. Romano-Bertrand, A. Bourdier, F. Aujoulat et al., “Skin microbiota is the main reservoir of *Roseomonas mucosa*, an emerging opportunistic pathogen so far assumed to be environmental,” *Clinical Microbiology and Infection*, vol. 22, no. 8, pp. 737.e1–737.e7, 2016.
  - [8] K. Okamoto, A. Ayibieke, R. Saito et al., “A nosocomial cluster of *Roseomonas mucosa* bacteremia possibly linked to contaminated hospital environment,” *Journal of Infection and Chemotherapy*, vol. 26, no. 8, pp. 802–806, 2020.
  - [9] P. Ioannou, V. Mavrikaki, and D. P. Kofteridis, “*Roseomonas* species infections in humans: a systematic review,” *Journal of Chemotherapy*, vol. 32, no. 5, pp. 226–236, 2020.
  - [10] S. Shao, X. Guo, P. Guo, Y. Cui, and Y. Chen, “*Roseomonas mucosa* infective endocarditis in patient with systemic lupus erythematosus: case report and review of literature,” *BMC Infectious Diseases*, vol. 19, no. 1, p. 140, 2019.
  - [11] K. Y. Kim, J. Hur, W. Jo et al., “Infectious spondylitis with bacteremia caused by *Roseomonas mucosa* in an immunocompetent patient,” *Infect Chemother*, vol. 47, no. 3, pp. 194–196, 2015.
  - [12] M. Vakili and N. F. Crum-Cianflone, “Spinal epidural abscess: a series of 101 cases,” *The American Journal of Medicine*, vol. 130, no. 12, pp. 1458–1463, 2017.
  - [13] R. O. Darouiche, “Spinal epidural abscess,” *New England Journal of Medicine*, vol. 355, no. 19, pp. 2012–2020, 2006.
  - [14] Y. Matsukuma, K. Sugawara, S. Shimano et al., “A case of bacterial peritonitis caused by *Roseomonas mucosa* in a patient undergoing continuous ambulatory peritoneal dialysis,” *CEN Case Rep*, vol. 3, no. 2, pp. 127–131, 2014.
  - [15] S. Roy, S. Patel, H. Kummamuru, A. S. Garcha, R. Gupta, and S. Adapa, “*Roseomonas mucosa*-induced peritonitis in a patient undergoing continuous cyclic peritoneal dialysis: case report and literature analysis,” *Case Reports in Nephrology*, vol. 2021, Article ID 1979332, 4 pages, 2021.
  - [16] G. B. Christakis, S. Perlorentzou, P. Alexaki, A. Megalakaki, and I. K. Zarkadis, “Central line-related bacteraemia due to *Roseomonas mucosa* in a neutropenic patient with acute myeloid leukaemia in Piraeus, Greece,” *Journal of Medical Microbiology*, vol. 55, no. 8, pp. 1153–1156, 2006.
  - [17] A. L. Michon, L. Saumet, A. Bourdier, S. Haouy, N. Sirvent, and H. Marchandin, “Bacteremia due to imipenem-resistant *Roseomonas mucosa* in a child with acute lymphoblastic leukemia,” *Journal of Pediatric Hematology*, vol. 36, no. 3, pp. e165–e168, 2014.
  - [18] M. A. Boyd, M. B. Laurens, P. D. Fiorella, and S. R. Mendley, “Peritonitis and technique failure caused by *Roseomonas mucosa* in an adolescent infected with HIV on continuous cycling peritoneal dialysis,” *Journal of Clinical Microbiology*, vol. 50, no. 11, pp. 3801–3804, 2012.
  - [19] M. Abu Choudhury, A. M. Wailan, H. E. Sidjabat et al., “Draft genome sequence of *Roseomonas mucosa* strain AU37, isolated from a peripheral intravenous catheter,” *Genome Announcements*, vol. 5, no. 15, 17 pages, Article ID e00, 2017.
  - [20] T. W. McLean, K. Rouster-Stevens, C. R. Woods, and A. K. Shetty, “Catheter-related bacteremia due to *Roseomonas* species in pediatric hematology/oncology patients,” *Pediatric Blood and Cancer*, vol. 46, no. 4, pp. 514–516, 2006.
  - [21] Y. M. Lee, C. Moon, Y. J. Kim, H. J. Lee, M. S. Lee, and K. H. Park, “Clinical impact of delayed catheter removal for patients with central-venous-catheter-related Gram-negative bacteraemia,” *Journal of Hospital Infection*, vol. 99, no. 1, pp. 106–113, 2018.
  - [22] R. S. Waris, M. Ballard, D. Hong, and T. B. Seddik, “Meningitis due to *Roseomonas* in an immunocompetent adolescent,” *Access Microbiology*, vol. 3, no. 3, p. 213, 2021.
  - [23] I. Dé, K. V. Rolston, and X. Y. Han, “Clinical significance of *Roseomonas* species isolated from catheter and blood samples: analysis of 36 cases in patients with cancer,” *Clinical Infectious Diseases*, vol. 38, no. 11, pp. 1579–1584, 2004.
  - [24] S. Elshibly, J. Xu, R. B. McClurg et al., “Central line-related bacteremia due to *Roseomonas mucosa* in a patient with diffuse large B-cell non-Hodgkin’s lymphoma,” *Leukemia and Lymphoma*, vol. 46, no. 4, pp. 611–614, 2005.
  - [25] N. V. Sipsas, J. Papaparaskevas, I. Stefanou, K. Kalatzis, P. Vlachoyiannopoulos, and A. Avlami, “Septic arthritis due to *Roseomonas mucosa* in a rheumatoid arthritis patient receiving infliximab therapy,” *Diagnostic Microbiology and Infectious Disease*, vol. 55, no. 4, pp. 343–345, 2006.
  - [26] J. D. Bard, J. G. Deville, P. H. Summanen, and M. A. Lewinski, “*Roseomonas mucosa* isolated from bloodstream of pediatric patient,” *Journal of Clinical Microbiology*, vol. 48, no. 8, pp. 3027–3029, 2010.
  - [27] S. Maraki, V. Bantouna, E. Lianoudakis, I. Stavrakakis, and E. Scoulica, “*Roseomonas* spinal epidural abscess complicating instrumented posterior lumbar interbody fusion,” *Journal of Clinical Microbiology*, vol. 51, no. 7, pp. 2458–2460, 2013.
  - [28] K. A. Al-Anazi, H. AlHashmi, B. Abdalhamid et al., “*Roseomonas* bacteremia in a recipient of an allogeneic hematopoietic stem cell transplantation,” *Transplant Infectious Disease*, vol. 15, no. 4, pp. E144–E147, 2013.
  - [29] Y. K. Kim, J. S. Moon, K. E. Song, and W. K. Lee, “Two cases of bacteremia due to *Roseomonas mucosa*,” *Annals of Laboratory Medicine*, vol. 36, no. 4, pp. 367–370, 2016.
  - [30] M. Bhende, A. Karpe, S. Arunachalam, K. L. Therese, and J. Biswas, “Endogenous endophthalmitis due to *Roseomonas mucosa* presenting as a subretinal abscess,” *Journal of Ophthalmic Inflammation and Infection*, vol. 7, no. 1, p. 5, 2017.
  - [31] N. Diesendorf, S. Köhler, W. Geißdörfer, T. Grobeger-Karl, M. Karl, and A. Burkovski, “Characterisation of *Roseomonas*

- mucosa isolated from the root canal of an infected tooth,” *BMC Research Notes*, vol. 10, no. 1, p. 212, 2017.
- [32] K. Kimura, H. Hagiya, I. Nishi, H. Yoshida, and K. Tomono, “Roseomonas mucosa bacteremia in a neutropenic child: a case report and literature review,” *IDCases*, vol. 14, Article ID e00469, 2018.
  - [33] N. Beucler, M. Meyer, A. Choucha, P. Seng, and H. Dufour, “Peritonitis caused by Roseomonas mucosa after ventriculoperitoneal shunt revision: a case report,” *Acta Neurochirurgica*, vol. 162, no. 10, pp. 2459–2462, 2020.
  - [34] J. Spindel, M. Grigorov, M. Baker, and L. Marsano, “Cardiac tamponade due to perforation of a Roseomonas mucosa pyogenic hepatic abscess as initial presentation of hepatoid carcinoma,” *BMJ Case Reports*, vol. 15, no. 3, Article ID e248947, 2022.
  - [35] C. M. Wang, C. C. Lai, C. K. Tan et al., “Clinical characteristics of infections caused by Roseomonas species and antimicrobial susceptibilities of the isolates,” *Diagnostic Microbiology and Infectious Disease*, vol. 72, no. 3, pp. 199–203, 2012.
  - [36] W. W. Rudolph, F. Gunzer, M. Trauth, B. Bunk, R. Bigge, and P. Schröttner, “Comparison of VITEK 2, MALDI-TOF MS, 16S rRNA gene sequencing, and whole-genome sequencing for identification of Roseomonas mucosa,” *Microbial Pathogenesis*, vol. 134, Article ID 103576, 2019.
  - [37] S. Tsuchida, H. Umemura, and T. Nakayama, “Current status of matrix-assisted laser desorption/ionization-time-of-flight mass spectrometry (MALDI-TOF MS) in clinical diagnostic microbiology,” *Molecules*, vol. 25, no. 20, p. 4775, 2020.
  - [38] E. Bouza and A. Burillo, “Current international and national guidelines for managing skin and soft tissue infections,” *Current Opinion in Infectious Diseases*, vol. 35, no. 2, pp. 61–71, 2022.