

A Rare Case of a Subcutaneous Abscess Caused by *Nocardia cyriacigeorgica* in an Immunocompetent Patient

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Background: *Nocardia cyriacigeorgica*, which mainly causes pleuropulmonary and disseminated nocardiosis, has been proved to be one of the most common opportunistic pathogens in patients with immunodeficiency, but the cases that cause subcutaneous abscesses in normal individuals are rare and should be paid attention to.

Methods: The clinical data of a patient with cutaneous nocardiosis caused by *Nocardia cyriacigeorgica* in Zhejiang Provincial People's Hospital were retrospectively analyzed, including clinical manifestations, laboratory examinations, imaging examinations, medication and prognosis.

Results: Magnetic resonance imaging (MRI) showed that there was a 26 mm × 73 mm abscess under the skin. The pus in the abscess was green. Gram staining showed positive branched rod-shaped and undivided hyphae. After culture, small wrinkle dry white small colonies were observed, and it was identified as *Nocardia cyriacigeorgica* by MALDI-TOF MS.

Conclusion: We report the first case of a subcutaneous abscess caused by *Nocardia cyriacigeorgica* in an immunocompetent patient. Compared with cutaneous nocardiosis of which approximately 80% caused by *Nocardia brasiliensis* invasion, infection of *Nocardia cyriacigeorgica* is more insidious and latent, the features of the lesions are also unique. For this *Nocardia cyriacigeorgica* clinical isolate, the tested antibacterial drugs are generally sensitive and have an ideal prognosis after treatment with linezolid and timely debridement.

Keywords: *Nocardia cyriacigeorgica*, subcutaneous abscess, nocardiosis, matrix-assisted laser desorption ionization-time-of-flight mass spectrometry, MALDI-TOF MS, debridement

Introduction

Nocardia are aerobic saprophytes ubiquitously found in aquatic habitats, decaying organic matter and various soil types.¹ Out of more than 100 defined subtypes to date, only approximately 30 of which are significance to human disease.² *Nocardia cyriacigeorgica* (*N. cyriacigeorgica*) is recognized as an emerging pathogenic bacterium commonly manifesting as a localized or systemic infection in the immunocompromised population since it was first described and redefined from the bronchial secretion of a patient with chronic bronchitis in Germany in 2001 by Yassin.^{3,4} The most typical clinical manifestations of *N. cyriacigeorgica* are pleuropulmonary and disseminated infection mainly involved in patients with acquired immunodeficiency syndrome (AIDS), corticosteroid maintenance, ongoing malignancy and those with solid organ transplant and hematopoietic stem cell transplant recipients, who are deficient in T cell-mediated immunity.⁵⁻¹⁰ Nocardiosis caused by *N. cyriacigeorgica* is

rare in immunocompetent hosts, usually acquired by wound infection after invasive surgery and inoculation on damaged skin with festering and scabbing.¹¹ *N. cyriacigeorgica*-related subcutaneous abscesses are potentially leading to clinical misdiagnosis because they rare in clinical and asymptomatic with insidious manifestations. We reported a case of a subcutaneous abscess caused by *N. cyriacigeorgica* infection in an immunocompetent individual in order to increase the clinical understanding of the emerging infectious manifestations of *N. cyriacigeorgica*.

Case Presentation

Clinical Features

A 47-year-old woman was admitted to the hospital due to lumbago with radiating pain of right lower limb, waist distension and numbness for 3 weeks, and the symptoms got worse 4 days ago. After admission, physical examination and medical history examination found no murmur was heard in the auscultation area of each valve, no history of long-term drug use and the abdomen was soft. The right lower limb straight leg elevation test was 50 degrees (+), and the enhancement experiment was not cooperative. The patient's temperature was normal, and he had no history of hypertension and diabetes. Abnormal elevation of neutrophils (75.6%) and C-reactive protein (CRP) (29.1 mg/L) were indicated by blood routine examination (Table 1).

Magnetic Resonance Imaging and Computed Tomography Examination

Magnetic resonance imaging (MRI) of vertebra lumbalis showed lumbar disc herniation in L4/5 and L5/S1, dural sac damage, spinal canal stenosis and lumbar degenerative change. In addition, the size of the subcutaneous abnormal signal focus on the lumbar back was 26 mm × 73 mm, with low signal intensity on T1WI and high signal intensity on T2WI, and the boundary was vague, indicating that it was a subcutaneous abscess (Figure 1A). The chest radiograph showed that the patient's lungs were normal (Figure 1B).

Table 1 Clinical and Laboratory Indicators of the Patient

Laboratory Indicators/Clinical Indicators	Measurements/Measurements	Normal Interval
WBC	6.83×10^9 /L	$3.5-9.5 \times 10^9$ /L
Lymphocytes	17.4%	20–50%
Monocytes	5.3%	3–10%
Neutrophils	75.6%	40–75%
Eosinophils	0.09×10^9 /L	$0.02-0.52 \times 10^9$ /L
Basophils	0.03×10^9 /L	$0-0.06 \times 10^9$ /L
RBC	3.98×10^{12} /L	$3.8-5.1 \times 10^{12}$ /L
Hemoglobin	121 g/L	115–150 g/L
Platelets	196×10^9 /L	$125-350 \times 10^9$ /L
CRP	29.1 mg/L	<10 mg/L
ESR	2 mm/h	<26 mm/h
Right iliopsoas MS	Level 5	
MS of right quadriceps femoris	Level 5	
Right foot dorsum extensor MS	Level 1	
Right foot planar flexor MS	Level 5	
Right great toe Dorsum flexor MS	Level 1	
Right plantar flexor MS	Level 5	
Tendon reflex	++	
Blood pressure	115/79 mmHg	
Respiratory rate	18 Breaths/minute	
Heart rate	75 Beats/minute	
Temperature	36.9°C	

Abbreviations: WBC, white blood cell count; RBC, red blood cell count; C-reactive protein, CRP; ESR, erythrocyte sedimentation rate; MS, muscle strength.

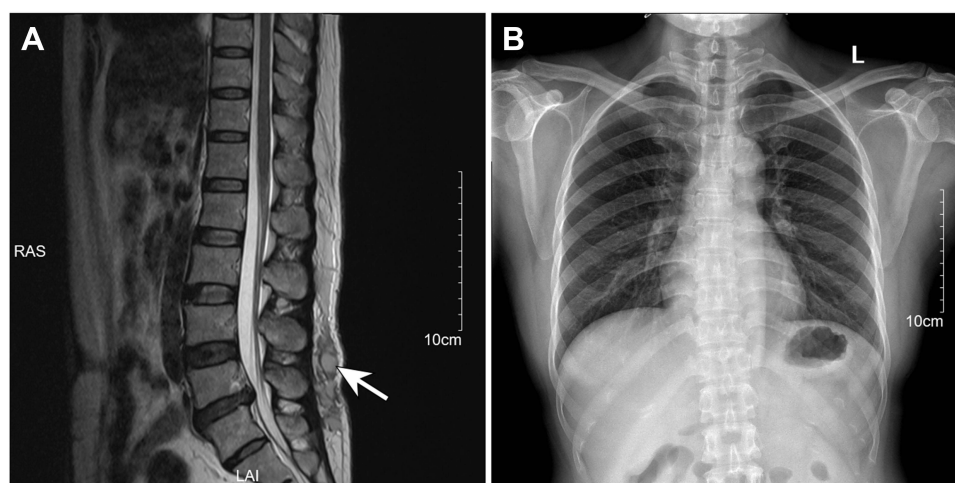


Figure 1 Imaging examination. (A) Magnetic resonance imaging (MRI) of vertebra lumbalis showed a 26 mm × 73 mm subcutaneous abscess with low signal intensity on T1WI and high signal intensity on T2WI (arrows). (B) The chest radiograph showed that the patient's lungs were normal.

Etiological Examination

Specimen handling and the identification procedures were followed standard laboratory protocols. Gram staining and acid-fast staining were performed on the pus extracted from the abscess, and the observation under the oil microscope showed that it was branching gram-positive rod and partially acid-fast, suggesting that it was likely to belong to *Nocardia* spp (Figure 2A and B). After the pus was cultured on the blood plate for 3 days, white colonies of different sizes could be

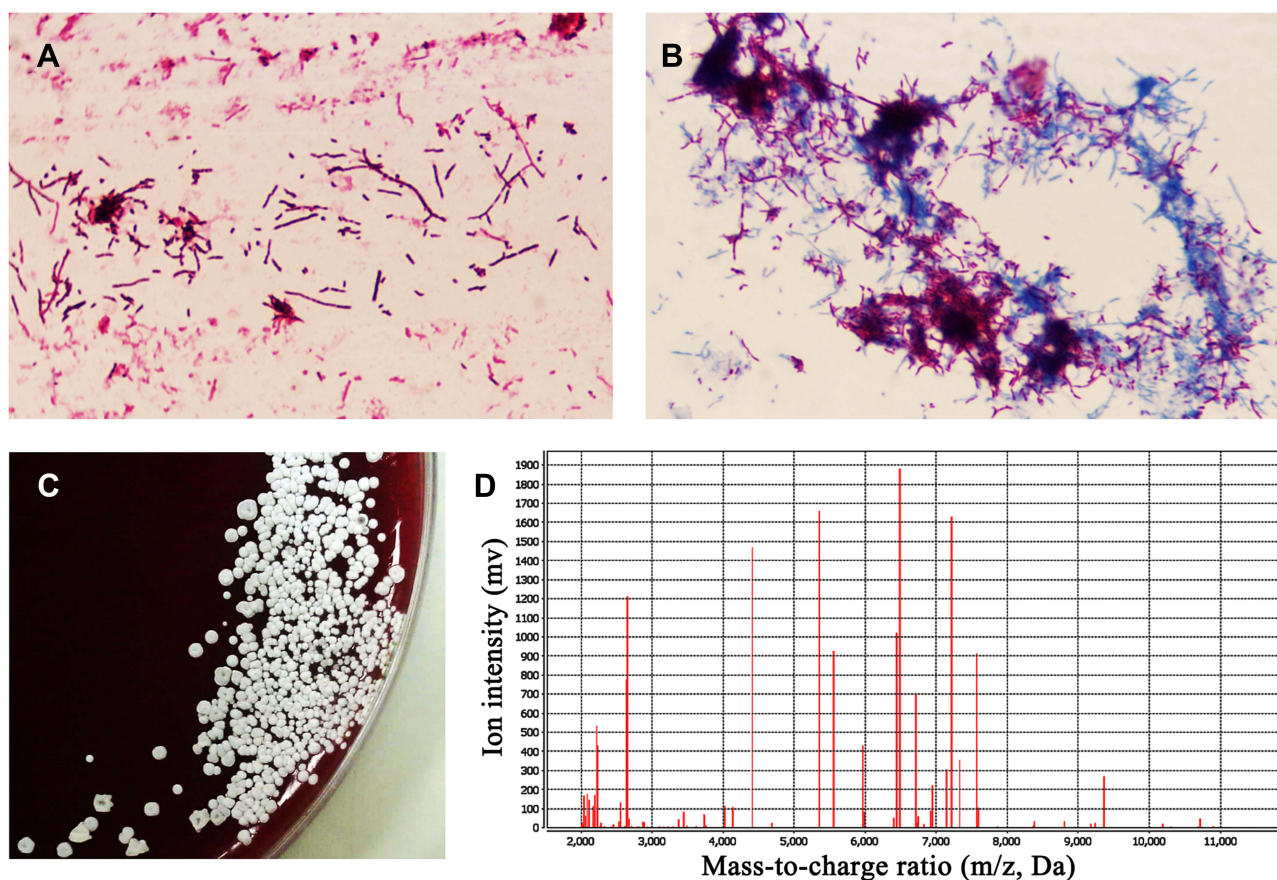


Figure 2 Pathogenic examination. (A) Gram-positive and branching rod-shaped bacterium was observed by Gram staining under oil mirror (×1000 magnification). (B) Acid fast staining showed weak positive mycelia, which proved that it was probably *Nocardia* spp. (C) Wrinkled, dry and white colonies of different sizes were observed by culture on the blood plate. (D) Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry (MALDI-TOF MS) confirm it was *Nocardia cyriacigeorgica*.

Table 2 Antimicrobial Susceptibility of the *Nocardia Cyriacigeorgica* by Kirby–Bauer method and Epsilometer Test

Antibiotics	Method	Result	Breakpoint	Unit	Interpratation
Amoxicillin/clavulanic acid	Etest	4	8–32	µg/mL	S
Amikacin	KB	23	–	mm	–
Clarithromycin	KB	15	–	mm	–
Minocycline	KB	18	–	mm	–
Imipenem	Etest	0.25	1–4	µg/mL	S
Linezolid	Etest	1	4–8	µg/mL	S
Levofloxacin	Etest	8	–	µg/mL	–

seen. The colony was dry or waxy, with wrinkles and particles on its surface (Figure 2C). The colonies were identified by Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry (MALDI-TOF MS) (bioMerieux, France) with 99.9% confidence value as *N. cyriacigeorgica* (Figure 2D). Kirby–Bauer method (KB) was performed to determine the maximum zone of inhibition (Zoi), and Epsilometer test (E-test) was performed to determine the minimum inhibitory concentration (MIC) value of the isolated *N. cyriacigeorgica* strain against amoxicillin/clavulanic acid, amikacin, clarithromycin, minocycline, imipenem, linezolid, levofloxacin, ceftriaxone (Table 1). Antibiotic susceptibility results of the *N. cyriacigeorgica* were judged by the Clinical and Laboratory Standards Institute (CLSI) interpretive breakpoints (CLSI M24: Susceptibility Testing of *Mycobacteria*, *Nocardia* spp., and Other Aerobic Actinomycetes). The isolated strain *N. cyriacigeorgica* was sensitive to the tested antibiotics, except for ceftriaxone (Table 2).

Debridement

The patient was treated with vacuum sealing drainage (VSD). The skin tissue was cut open, and the abscess was found under the skin, and the pus was sucked up. The wound was washed with hydrogen peroxide and normal saline, and the wound was filled with VacuSeal. The pus was green, and further pathogenic examination was carried out.

Medication and Prognosis

According to the results of antibiotic sensitivity, the patient took 0.6 g linezolid orally twice a day for antibacterial treatment. After 2 months, the patient's pain was relieved, and the inflammatory indicators neutrophils (68.4%) and CRP (1.0 mg/L) returned to normal.

Discussion

Nocardiosis has been recognized as an emerging communicable disease with an incidence rate of approximately 500–1000 cases in the United States every year, of which 60% are described in immunocompromised patients and about 10% are cutaneous in nature.¹² Approximately 80% of cutaneous nocardiosis are caused by *Nocardia brasiliensis*¹³; thus we report the first case of a subcutaneous abscess caused by *N. cyriacigeorgica* in an immunocompetent patient in this area. Traumatic inoculation of skin by *Nocardia brasiliensis* progresses to cellulitis, nodules, impetigo, pyoderma, sporotrichosis-like lymphangitis, chronic pyogenic granuloma, multiple fistula or cutaneous involvement in hematogenous dissemination, mainly reported in patients with advanced AIDS and immunocompetent farmers with skin wounds, which were more common in the legs and feet, called mycetoma.^{14–16} Unlike previously reported cutaneous nocardiosis, which usually infect exposed wounds and cause suppuration, in this case, the patient is immunocompetent and has no skin lesion. *Nocardia africana* colonies in invaded tissues and pus manifest whitish “sulfur” granules.¹⁷ However, in our case, the pus extracted from the *N. cyriacigeorgica* -related subcutaneous abscess was green, and this pathological phenomenon should be known by more clinical laboratory technicians. Without radioactive or ultrasonic examination, it is difficult to find the presence of the lesions. Compared with cutaneous nocardiosis caused by *Nocardia brasiliensis* invasion, infection of *N. cyriacigeorgica* is more insidious and latent.

At present, *Nocardia* cases that have been reported in detail are limited, the reported average age of patients impacted by *Nocardia* is 40 years old, and the infection risk of males is higher than females, with an incidence of 3:1.¹⁸ In this case, the patient with the subcutaneous abscess caused by *N. cyriacigeorgica* infection was a 47-year-old woman. Sulfonamides are the first-line antibiotics for treating disseminated nocardiosis and usually combine with amikacin, linezolid or imipenem.¹⁹ Most reported *N. cyriacigeorgica* strains are generally susceptible to sulfonamides, broad-spectrum cephalosporins, amikacin, imipenem, and linezolid but resistant to penicillins, clarithromycin, and ciprofloxacin with the exception of a few strains that have been reported to be susceptible to ciprofloxacin.^{4,20,21} The isolated strain *N. cyriacigeorgica* from this patient was sensitive to amoxicillin/clavulanic acid, amikacin, clarithromycin, minocycline, imipenem, linezolid, levofloxacin, except for ceftriaxone in vitro. *N. cyriacigeorgica* (20.8%, 11/53) were reported in a study of 53 non-repetitive *Nocardia* isolates collected from 8 tertiary general hospitals of 7 cities in China with a 63.6% (7/11) resistance rate of ciprofloxacin.²² In general, linezolid is still absolutely sensitive to all *N. cyriacigeorgica* strains.

Conclusion

In conclusion, we report the first case of a subcutaneous abscess caused by *N. cyriacigeorgica* in an immunocompetent patient. Compared with cutaneous nocardiosis of which approximately 80% caused by *Nocardia brasiliensis* invasion, infection of *N. cyriacigeorgica* is more insidious and latent, the features of the lesions are also unique. For this *N. cyriacigeorgica* clinical isolate, the tested antibacterial drugs are generally sensitive and have an ideal prognosis after treatment with linezolid. Awareness of *N. cyriacigeorgica* as a distinct pathogenic entity in immunocompetent patients and accurate clinical diagnosis should be emphasized.

Ethics Approval and Consent to Participate

This study was supported by the Ethics Committee of Zhejiang People's Hospital (Ethics Committee Approval of Biomedical Research Involving Humans, Approval No. 2022JS008) and was carried out in accordance with the ethical standards of the Declaration of Helsinki.

Consent for Publication

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

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Disclosure

The authors declare that they have no competing interests in this work.

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