



만성 폐쇄성 폐질환으로 저용량 스테로이드 유지 중인 환자에게 발생한 *Nocardia abscessus*에 의한 다발성 근육 농양 1예

순천향대학교 서울병원 ¹진단검사의학과, ²감염내과

김정아¹ · 동현주¹ · 이은정² · 정종택² · 백예지² · 김태형² · 최태윤¹

Multiple Intramuscular Abscesses Caused by *Nocardia abscessus* in a Patient with Chronic Obstructive Lung Disease: Clinical Microbiology Considerations

Jung-Ah Kim¹, Hyunjoo Dong¹, Eunjung Lee², Jongtak Jung², Yae Jee Baek², Tae Hyong Kim², and Tae Youn Choi¹

¹Department of Laboratory Medicine, Soonchunhyang University Hospital Seoul, Seoul;

²Division of Infectious Diseases, Department of Internal Medicine, Soonchunhyang University Hospital Seoul, Seoul, Korea

Nocardiosis is uncommon. Immunocompromising conditions predispose individuals to pulmonary and disseminated nocardiosis of the brain, skin, and subcutaneous tissues. The most common pathogens are *Nocardia cyriacigeorgica*, *Nocardia nova*, and *Nocardia farcinica*. The speciation of *Nocardia* to determine antimicrobial susceptibility is difficult using traditional biochemical methods. Here, we report the case of a 73-year-old man with chronic obstructive lung disease who developed a rapidly progressing intramuscular abscess around the left hip and thigh. Within 3 days, the lesions progressed to an epidural abscess at the L4 to S1 level. Although he was treated with broad-spectrum antibiotics and extensive incision and drainage, he died of rapidly progressive respiratory failure. *Nocardia abscessus* (*N. abscessus*) was identified in pus samples using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS). This case shows that the diagnosis of an intramuscular abscess caused by *N. abscessus* is challenging and that using MALDI-TOF MS may facilitate the diagnosis and ensure appropriate treatment. (Korean J Med 2024;99:50-56)

Keywords: *Nocardia abscessus*; Intramuscular abscess; Immunocompromised host; MALDI-MS

INTRODUCTION

Nocardia species are aerobic, Gram-positive, beaded, weakly acid-fast, branching rods. Nocardiosis results from infection by

members of the genus *Nocardia*, which are ubiquitous environmental saprophytes that cause localized or disseminated diseases in humans via inhalation or inoculation [1]. Immunocompromised individuals with deficient cell-mediated immunity, especially that

Received: 2023. 7. 31

Revised: 2023. 10. 9

Accepted: 2023. 10. 10

Correspondence to Eunjung Lee, M.D., Ph.D.

Division of Infectious Diseases, Department of Internal Medicine, Soonchunhyang University Hospital Seoul, 59 Daesagwan-ro, Yongsan-gu, Seoul 04401, Korea

Tel: +82-2-709-9034, Fax: +82-2-709-9083, E-mail: shegets@schmc.ac.kr

Copyright © 2024 The Korean Association of Internal Medicine

This is an Open Access Article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

associated with lymphoma, transplantation, glucocorticoid therapy, or human immunodeficiency virus infection, are at risk for Nocardiosis [2]. Pneumonia is the most common form of *Nocardia* disease, and other common sites include the brain, skin and soft tissues, kidneys, joints, bones, and eyes [1-3]. Muscle involvement is rare and a typical manifestation of muscle infection is a subacute intramuscular abscess [4]. Here, we present a rare case of rapidly progressive multifocal intramuscular abscesses caused by *Nocardia abscessus* identified by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS).

CASE REPORT

A 73-year-old man presented to the emergency department with progressive back pain and pain radiating down the left leg that had worsened over the past 25 days. He also reported fever and chills. His medical history included chronic obstructive lung disease (COPD) treated with home O₂ therapy, prednisolone 5 mg/day, and montelukast sodium 10 mg/day. He had received an epidural nerve block 3 days previously.

On admission, he had a temperature of 38.7°C, heart rate of 120 beats/min, and blood pressure of 87/56 mmHg. His oxygen saturation was 88% while breathing ambient air. Physical exami-

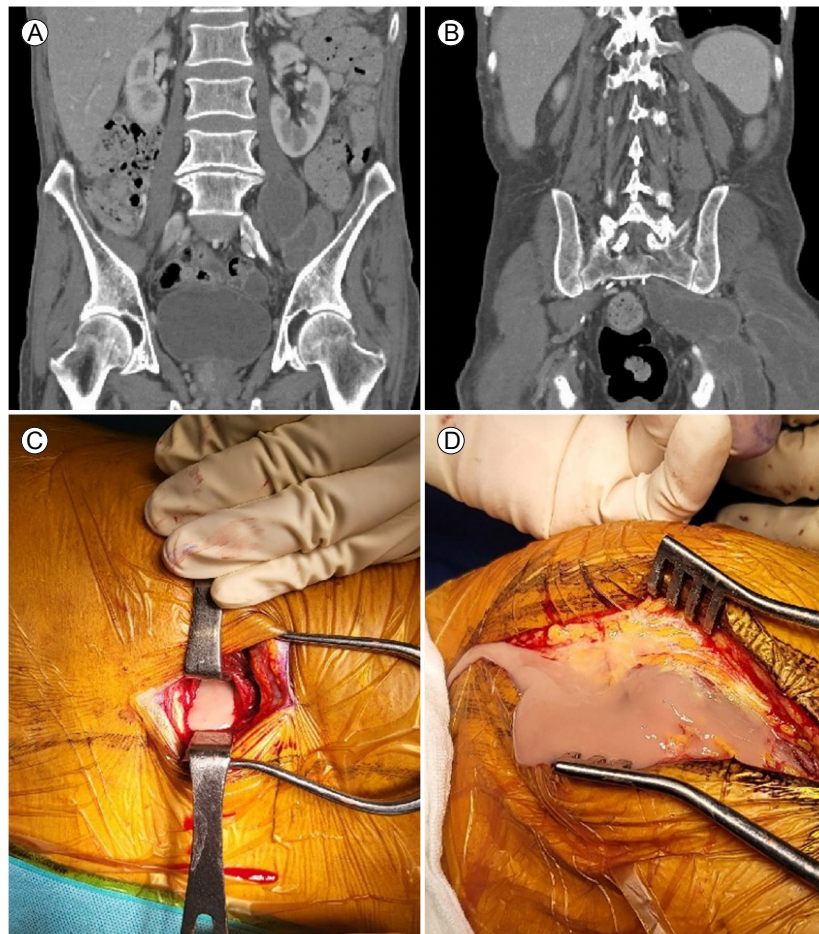


Figure 1. Radiological and intraoperative findings of the multifocal intramuscular abscess. (A) Abdominopelvic computed tomography reveals multiple peripheral enhancing fluid collections involving the left psoas and iliacus muscles. (B) Abdominopelvic computed tomography reveals multiple peripheral enhancing fluid collections involving the left gluteus maximus and piriformis. (C, D) A skin incision was made from 5 cm distal to the posterior superior iliac spine to 5 cm distal to the greater trochanter, and huge amounts of brownish pus gushed from the gluteus maximus.

nation revealed decreased sounds in both lungs and severe tenderness of the buttocks and left thigh. The motor and sensory functions of both legs were intact. Laboratory tests revealed a white blood cell count of $45.7/\mu\text{L}$, hemoglobin of 12.1 g/dL , platelet count of $407.0 \times 103/\mu\text{L}$, C-reactive protein level of 22.5 mg/dL (normal range, 0-0.5), procalcitonin level of 8.9 ng/mL , and lactic acid level of 3.0 mmol/L . Three sets of blood cultures on blood agar and MacConkey agar plates for 5 days were negative.

On the first day of admission, chest radiography and chest and abdominopelvic computed tomography (CT) showed extensive emphysema with chronic bronchitis, and revealed extensive intramuscular abscesses involving the left psoas, iliacus, spinalis thoracis, longissimus thoracis, gluteus maximus, and piriformis muscles (Fig. 1A, B). On the fourth day after admission, the pain in the left hip and thigh worsened despite the administration of broad-spectrum antibiotics (levofloxacin and vancomycin) and analgesics. Lumbar spine CT revealed a combined anterior epidural abscess at the L4 to S1 levels and suggested bony involvement of the left sacrum and lower lumbar spine. On the sixth day after admission, incision and pus drainage of the left iliopsoas, gluteal, and paravertebral abscesses were done

to relieve pain and as definitive treatment. Yellow and brown pus was released from the psoas, iliacus, and paraspinal muscles (Fig. 1C, D). The psoas and paraspinal muscle histopathology showed many acute inflammatory cells with macrophages in a necrotic background. Gram stain and culture of pus and tissue specimens from the psoas, iliacus, and paraspinal muscles and Gram staining of surgical specimens initially showed no bacteria, but after 2 days incubation, Gram-positive filamentous rods were observed on Gram staining of cultured colonies. Four hours after the colonies were grown, the bacteria were identified as *Nocardia abscessus* using MALDI-TOF MS (Fig. 2). On the eighth day after admission, the acute exacerbation of COPD continued to progress, despite mechanical ventilation and the administration of high-dose steroids, and the patient died.

DISCUSSION

The organs most frequently infected by *Nocardia* are the respiratory tract, brain, and skin/soft tissues [1-3]. Intramuscular nocardiosis is rare; to our knowledge, only 15 cases have been reported (Table 1), including six cases each of *Nocardia asteroides* (*N. asteroides*) and *Nocardia farcinica* [5-8]. The psoas is the most common

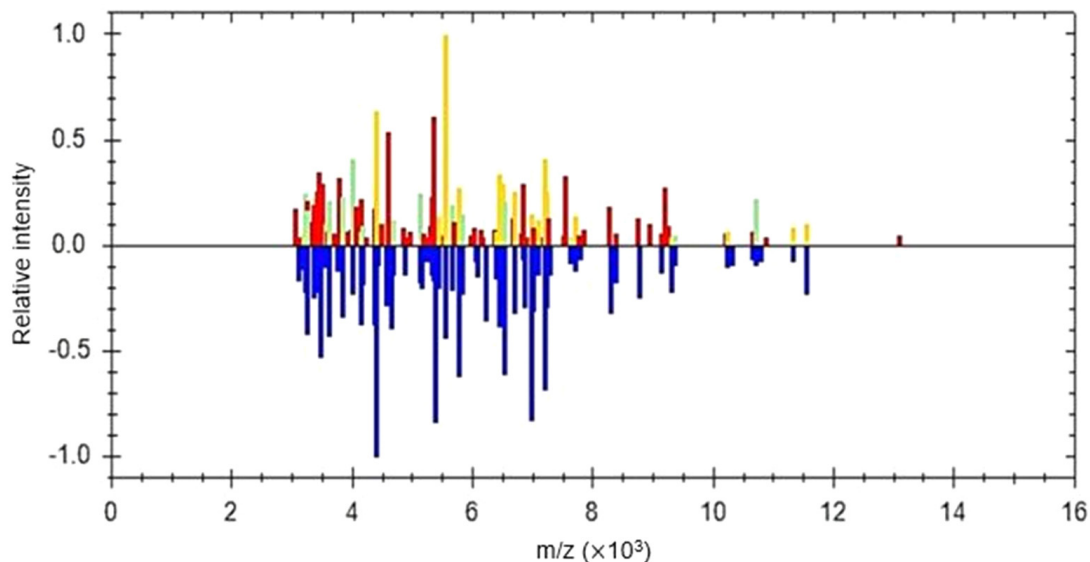


Figure 2. The fingerprint of *Nocardia abscessus* on MALDI-TOF MS. The sample spectrum is presented at the top and the matched database spectrum below it. The best match was with *Nocardia abscessus*. *m/z*, mass to charge ratio; MALDI-TOF MS, matrix-assisted laser desorption/ionization-time of flight mass spectrometry.

Table 1. Clinical characteristics of muscle abscesses due to *Nocardia* infection: a review of literature

Case No.	Age, years/sex	Predisposing condition (occupation)	Immuno-suppressant	Parts of muscle with abscess	Other organs	Species (ID period ^b)	Treatment regimen	Dose and duration	Out-come
1	39/M	NA	NA	Both psoas	Brain, spleen, lung	<i>N. brasiliensis</i> (after death)	Sulfonamide	NA	Died
2	44/M	KT, valvular heart disease	Cyclosporine, prednisolone	Right psoas, ^a gluteus maximus	-	NA (17 days)	TMP/SMX	NA	Cured
3	61/M	CLL (gardener)	Cyclo-phosphamide, vincristine	Right psoas	Lung	<i>N. asteroides</i>	Minocycline	100 mg q12h, 4 months	Cured
4	61/M	KT	Cyclosporine, azathioprine, prednisolone	Right biceps brachii	Lung	<i>N. asteroides</i>	TMP/SMX	NA, 12 months	Cured
5	58/M	HT (gardener)	Cyclosporine, azathioprine	Left adductor	-	<i>N. asteroides</i>	TMP/SMX	960 mg q12h, 1 year	Cured
6	42/M	-(cattle inspector)	-	Left psoas	-	<i>N. farcinica</i> (17 days)	TMP/SMX	10 mg/kg q24h and 50 mg/kg q24h, 11 months	Cured
7	40/M	Wound dehiscence after 3rd KT	Prednisolone, mycophenolate mofetil, tacrolimus	Right deltoid	Lung	<i>N. asteroides</i>	TMP/SMX	800 mg q12h and 160 mg q12h, 2 weeks 400 mg q12h and 80 mg q12h, 1 year	Cured
8	32/F	SLE, lupus nephritis	Cyclo-phosphamide, prednisolone	Left deltoid	-	<i>N. farcinica</i> (12 days)	TMP/SMX	NA	Cured
9	65/F	Hodgkin's lymphoma	Methotrexate, vinblastine, bleomycin	Right vastus lateralis	-	<i>N. farcinica</i>	TMP/SMX	160 mg q12h and 800 mg q12h, 3 months	Cured
10	76/M	Suspicion of Rheumatic disorder	Corticosteroid	Left gracilis	-	<i>N. farcinica</i>	TMP/SMX	1,920 mg q12h, 3 months	Cured
11	46/M	Obesity, alcoholism	-	Ilio-psoas	Maxilla, ^a spinal disk	<i>N. asteroides</i> (7 days)	Impipem, amikacin, rifampin	NA, 4 months	Cured
12	32/M	AIDS, hepatitis C, alcoholism	-	Left paravertebral, psoas, maximus gluteus ^a	Lung	<i>N. asteroides</i>	TMP/SMX, ciprofloxacin	NA	Cured

Table 1. Continued

Case No.	Age, years/sex	Predisposing condition (occupation)	Immunosuppressant	Parts of muscle with abscess	Other organs	Species (ID period ^b)	Treatment regimen	Dose and duration	Out-come
13	61/F	SLE, lupus nephritis	Prednisolone	Left psoas	Lung	<i>N. farcinica</i>	TMP/SMX ceftriaxone, ciprofloxacin	160-800 mg q8h, 9 days (azotemia) 2 g q24h, 4 weeks 200 mg q12h, 12 weeks	Cured
14	59/F	Autoimmune hemolytic anemia	Prednisolone	Left biceps femoris ^a	Lung, brain	<i>N. farcinica</i> (9 days)	TMP/SMX, imipemen, amikacin	4,000-9,000 mg q24h, 9 months 2,000 mg q24h, 5 months	Cured
15	79/M	Myasthenia gravis	Steroid	Both biceps femoris	Lung ^a	<i>N. pseudo-brasilienis</i>	Linezolid, moxifloxacin	800 mg q24h, 5 months NA, 3 weeks (thrombocyto-penia) NA, 6 months	Cured
This case	73/M	COPD, recurrent pneumo-thorax	Prednisolone, dexamethasone	Left psoas, ^a iliacus, spinalis thoracis, longissimus thoracis, gluteus maximus, piriformis	-	<i>N. abscessus</i> (2 days)	Levofloxacin, vancomycin	750 mg q24h, 7 days 900-1,000 mg q12h, 7 days	Died

ID, identification; M, male; NA, not available; *N. brasiliensis*, *Nocardia brasiliensis*; KT, kidney transplantation; TMP/SMX, trimethoprim/sulfamethoxazole; CLL, chronic lymphocytic leukemia; *N. asteroides*, *Nocardia asteroides*; HT, heart transplantation; *N. farcinica*, *Nocardia farcinica*; F, female; SLE, systemic lupus erythematosus; AIDS, acquired immune deficiency syndrome; COPD, chronic obstructive pulmonary disease; *N. pseudo-brasilienis*, *Nocardia pseudo-brasilienis*; *N. abscessus*, *Nocardia abscessus*.

^aPrimary organ of infection suspected by the authors of the literature.

^bPeriod until identifying *Nocardia* after hospitalization.

site of intramuscular infection due to its rich vascular nature, and a secondary psoas abscess may occur as local spread from the viscera along the iliopsoas. In an analysis of 93 psoas abscesses for which the causative microorganisms were identified over 15 years [9], there was one case of *Nocardia* (*N. asteroides*). In a literature review (Table 1), in 6/15 (40%) of cases, the muscle was the primary site of infection; in 9/15 (60%) of cases, multiple organs such as lung, brain, bone, and spleen were co-infected. Most (13/15 cases; 87%) patients were immunocompromised and three patients (cases 3, 5, and 6), including an immunocompetent patient, had jobs with a risk of *Nocardia* inhalation or inoculation. In our case, although 5 mg/day prednisolone is not an immunosuppressive dose, inhalation might have been a route of *Nocardia* infection, considering the patient's very severe COPD with home O₂ therapy and bed-ridden state.

As empirical antibiotics for typical intramuscular abscesses are not effective for abscesses caused by *Nocardia* species, identification and antibiotic susceptibility tests followed by culture should not be delayed. Since *Nocardia* has a low blood culture detection rate of 38% and a median incubation time of 4 days [10], incision and drainage should be performed to obtain samples as soon as possible. As intramuscular abscesses are usually subacute, there was usually sufficient time to identify the *Nocardia* species and prescribe specific antibiotics in most of the reported cases (Table 1). However, our patient had an acute manifestation of Nocardiosis and died before the final culture results were available. Although only 2 days were taken to identify the *Nocardia abscessus* (*N. abscessus*), incision and drainage were delayed due to the patient's unstable general condition and were performed after the sixth day of hospitalization. Empirical antibiotics for intramuscular abscesses, such as levofloxacin and vancomycin, ultimately proved ineffective. Case 1 in the literature review (Table 1), was lost to follow-up after using penicillin without microbial identification and died 3 months later due to dissemination. We suspected *Nocardia* in that case because filamentous shapes were observed on Gram staining. The differential diagnosis of Gram-positive rods includes *Corynebacterium*, *Listeria*, *Lactobacillus*, *Actinomyces* (mainly as bacterial contaminants), and *Nocardia* species. If the Gram-positive rods are filamentous, *Nocardia* should be considered. Moreover, if staining for acid-fast bacilli reveals specific aerial hyphae, it

helps to confirm *Nocardia* [1]. If cultured, *Nocardia* can be identified accurately using MALDI-TOF MS or 16S rRNA sequencing [1-3]. MALDI-TOF MS is used more commonly, owing to its short time and ease of use compared with 16S rRNA sequencing. The concordance between MALDI-TOF MS and 16S rRNA sequencing at the species/complex level is 97.3% [3].

The 2019 updated guidelines for *Nocardia* infection [10] recommended that the initial selection of an antimicrobial regimen be based on the *Nocardia* species. *N. abscessus* is generally susceptible to trimethoprim/sulfamethoxazole (TMP/SMX), amikacin, ceftriaxone, amoxicillin-clavulanic acid, tigecycline, variably susceptible to imipenem and minocycline, and resistant to ciprofloxacin, moxifloxacin, and clarithromycin/azithromycin. However, in an analysis over 10 years conducted in Spain [2], 2.8% and 4.2% of *N. abscessus* isolates were resistant to TMP/SMX and amoxicillin-clavulanic acid, respectively.

In summary, this case of multifocal intramuscular abscess caused by *N. abscessus* has educational value. Although the incidence of nocardiosis is increasing globally [10], intramuscular abscesses are still uncommon. This case highlights the importance of considering the possibility of *Nocardia* in patients with muscle abscesses and the value of using molecular techniques for identifying *Nocardia*.

중심 단어: *Nocardia abscessus*; 근육 내 농양; 면역저하자; MALDI-MS

CONFLICT OF INTEREST

No potential conflicts of interest relevant to this article was reported.

FUNDING

This research was supported by the Soonchunhyang University Research Fund.

AUTHOR CONTRIBUTIONS

Conceptualization: Jung-ah Kim, Eunjung Lee, Tae Hyong

Kim, Jongtak Jung, and Yae Jee Baek.

Data curation: Jung-ah Kim and Eunjung Lee.

Formal analysis: Jung-ah Kim.

Methodology: Hyunjoon Dong and Tae Youn Choi.

Writing - original draft: Jung-ah Kim and Eunjung Lee.

Writing - review & editing: Tae Youn Choi, Tae Hyong Kim, Eunjung Lee, Jongtak Jung, and Yae Jee Baek.

ACKNOWLEDGEMENTS

The authors thank the orthopedic surgeon, Sung-Woo Choi who performed incision and drainage despite the patient's critical condition, and the respiratory physician, Youngeun Jang who provided respiratory care to the patient after surgery.

REFERENCES

1. Galar A, Martín-Rabadán P, Marín M, et al. Revisiting nocardiosis at a tertiary care institution: any change in recent years? *Int J Infect Dis* 2021;102:446-454.
2. Valdezate S, Garrido N, Carrasco G, et al. Epidemiology and susceptibility to antimicrobial agents of the main *Nocardia* species in Spain. *J Antimicrob Chemother* 2017;72:754-761.
3. Toyokawa M, Ohana N, Ueda A, et al. Identification and antimicrobial susceptibility profiles of *Nocardia* species clinically isolated in Japan. *Sci Rep* 2021;11:16742.
4. López VN, Ramos JM, Meseguer V, et al. Microbiology and outcome of iliopsoas abscess in 124 patients. *Medicine (Baltimore)* 2009;88:120-130.
5. Berd D. *Nocardia brasiliensis* infection in the United States: a report of nine cases and a review of the literature. *Am J Clin Pathol* 1973;60:254-258.
6. Noh JY, Cheong HJ, Heo JY, et al. Pulmonary and psoas muscle nocardiosis in a patient with lupus nephritis: a case report and review of the literature. *Rheumatol Int* 2011;31:929-936.
7. Ukai Y, Fujimoto N, Fujii N, et al. Case of muscle abscess due to disseminated nocardiosis in a patient with autoimmune hemolytic anemia, and review of the published work. *J Dermatol* 2012;39:466-469.
8. Kandasamy VV, Nagabandi A, Horowitz EA, Vivekanandan R. Multidrug-resistant *Nocardia pseudobrasiliensis* presenting as multiple muscle abscesses. *BMJ Case Rep* 2015;2015:bcr2014205262.
9. Williams E, Jenney AW, Spelman DW. *Nocardia* bacteremia: a single-center retrospective review and a systematic review of the literature. *Int J Infect Dis* 2020;92:197-207.
10. Restrepo A, Clark NM; Infectious Diseases Community of Practice of the American Society of Transplantation. *Nocardia* infections in solid organ transplantation: guidelines from the Infectious Diseases Community of Practice of the American Society of Transplantation. *Clin Transplant* 2019;33:e13509.