Abstract
Background: A concurrent underlying infection must be considered when immunocompromised patients present with multiple muscle abscesses. Disseminated nocardiosis is a rare infectious disorder that may disseminate to the muscle and other tissues, including the central nervous system. Here we describe the case and management of an immunocompromised patient who presented with disseminated nocardiosis and multiple muscle abscesses. In such cases, the by surgical drainage of muscle abscesses and subsequent early diagnosis and identification of the causative organism may facilitate appropriate treatment.

Case Presentation
A 70-year-old woman was admitted with general fatigue and left lower abdominal and hip pain. She had a 10-year history of treatment with azathioprine and prednisolone for AQP4-antibody-related neuromyelitis optica spectrum disorders. Although her vital signs were normal, laboratory data indicated a C-reactive protein concentration of 22.9mg/dL, and computed tomography revealed a coin-sized lesion in her right lung and abscesses in the left abdominal oblique and gluteal muscles. A blood culture was positive for multidrug-resistant Staphylococcus epidermidis. We surgically drained the multilocular abscesses and conducted a bacteriological evaluation, which revealed the presence of Nocardia spp.

The patient recovered and was given a plan of sulfa-methoxazole–trimethoprim therapy for 6 months.

Conclusions
Regardless of the positive result of blood culture consistent with multiple abscess formation, we should consider for disseminated nocardiosis in immunocompromised patients. To prevent central nervous infection and relapse, aggressive bacteriological evaluation and appropriate antibiotics therapy may be essential.

Key words: nocardiosis, myositis, immunocompromised host

Declarations
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Consent for publication: Written informed consent was obtained from the patient for publication of this case report and its accompanying images.
Background

Pyomyositis is a purulent infection of the skeletal muscle that often arises from hematogenous spread (e.g., abscess formation). The reported incidence of this condition has increased with the liberal use of computed tomography (CT) for diagnostic purposes. The presence of multiple muscle abscesses may indicate a serious underlying medical problem, such as diabetes mellitus, malignancy, human immunodeficiency virus infection, or a rheumatologic condition; accordingly, a concurrent underlying infection must be considered in such cases.

Disseminated nocardiosis is an uncommon disorder that can cause localized or systemic supplicative disease. Affected patients tend to be immunocompromised, most often as a result of cell-mediated abnormalities. Nocardiosis can disseminate to virtually any organ, although it particularly affects central nervous system, and tends to progress or relapse despite appropriate therapy. Moreover, blood cultures for Nocardia spp. have a low detection rate and require a long period (i.e., several days) for isolation via ordinary methods.

We present the case of an immunocompromised patient with disseminated nocardiosis and pulmonary involvement that presented as multiple muscle abscesses. Regarding the management of this case, the surgical drainage of abscesses and subsequent early diagnosis and identification of Nocardia spp. may have contributed to decisions regarding the appropriate treatment.

Case Presentation

A 70-year-old woman was transferred from a local hospital to our institution with general fatigue and weakness in the lower extremities. She had a 28-year history of AQP4 antibody-related neuromyelitis optica, for which she had been treated with azathioprine (100mg/day) and prednisolone (10mg/day) for 10 years. At admission, her blood pressure, heart rate, body temperature, and respiratory rate were 118/78mmHg, 96 beats/minute, 36.7°C, and 18/min, respectively, and she complained of left lower abdominal and hip pain. There were weakness of psoas muscle and hamstrings of manual muscle test Grade 1 and 1, respectively. And quadriceps femoris muscles weakness were observed of manual muscle test Grade 2. Deep tendon reflex of bilateral lower legs were hypertonic. There was no other specific neurological deficit.

A laboratory analysis identified a C-reactive protein (CRP) concentration of 22.9mg/dL (Table 1). Contrast-enhanced computed tomography revealed a coin-sized lesion in her right lung (Fig. 1), and multiple abscesses in her left abdominal oblique and gluteal muscles (Fig. 2). Subsequently, she was diagnosed with multiple pyomyositis with a solitary lung lesion, and treated empirically with cephalazolin for a typical Staphylococcus infection. Magnetic resonance imaging of the brain and spine revealed no remarkable progress of the neuromyelitis optica or other infectious lesions, and echocardiography indicated no evidence suggestive of infectious endocarditis.

On hospital day 8, a blood culture sampled on the day of admission tested positive for multidrug-resist-
Disseminated nocardiosis with polypymyositis

Table 2  Bacterial culture results

| Hospital day | Specimen | Bacteria          |
|--------------|----------|-------------------|
| 0            | Blood    | Negative          |
| 6            | Blood    | MRSE              |
| 11           | Blood    | Negative          |
| 14           | Abscess  | GPR (ongoing)     |
| 30           | Abscess  | Nocardia spp.     |

MRSE: methicillin-resistant Staphylococcus epidermidis
GPR: gram-stain-positive rod

Fig. 2  Contrast-enhanced computed tomography revealed muscle abscesses in the left abdominal oblique (left) and gluteal muscles (right).

Fig. 3  Computed tomography image after a month of antibiotic therapy, indicating a lesion of the right lung was diminished.

Discussion

Nocardia spp. are ubiquitous aerobic, gram-positive, filamentous, and partly acid-fast soil saprophytic bacteria. In humans, nocardiosis usually affects immunocompromised hosts, and ranges from a self-limiting, subclinical condition to an acute, life-threatening and disseminated disease. The most common infection site is the lung, from which bacteria may disseminate to multiple sites, including the brain, kidneys, joints, soft tissues, and eyes, via hematogenous spread.

Pulmonary nocardiosis has been associated with mortality rates of 14%–40%; however, mortality increases significantly if the condition is complicated by a central nervous system infection. In immunocompromised patients, disseminated nocardiosis with central nervous system involvement is associated with a 55% mortality rate, which increases to above 85% without appropriate treatment. Unfortunately, nocardiosis is frequently misdiagnosed be-
cause of its non-specific manifestation and slow
growth in culture\textsuperscript{6}. Moreover, approximately 30% 
of nocardiosis cases involve concomitant bacteremia 
with other pathogens (mostly gram-negative organ-
isms)\textsuperscript{10}. Therefore, the identification of a microor-
ganism from blood or other samples might not ex-
clude a nocardial infection.

Nocardiosis rarely causes cutaneous infection, and 
such lesions are clinically indistinguishable from 
those produced by common pyogenic bacteria such 
as \textit{Staphylococcus aureus}; accordingly, the true inci-
dence of cutaneous \textit{nocardia} infection may be un-
derestimated. The identification of nocardiosis as 
the causative organism of cutaneous lesions might 
be delayed in the absence of an abscess culture. An 
initial pus evaluation that includes gram staining or 
modified acid-fast staining might lead to an initial 
suspicion of \textit{Nocardia} spp\textsuperscript{9}.

In the present case, the blood culture and imag-
ning findings did not provide evidence of nocardiosis 
and were consistent with the clinical features of 
staphylococcal bacteremia. We were going to drain-
age the abscesses later, but this information might 
have mimic us.

Accordingly, the patient was at risk of a misdiag-
nosis, which might have led to a central nervous 
system nocardial infection and relapse.

In addition, there was no evidence to suggest an 
optimal duration of microbial treatment; instead, we 
evaluated the relapse using serial clinical observa-
tions, particularly of the lung and brain. We note, 
however, that a poor prognosis has often been asso-
ciated with a delayed diagnosis and premature dis-
continuation of appropriate therapy\textsuperscript{10}.

\textbf{Conclusions}

Disseminated nocardiosis should be considered in 
the differential diagnosis of immunocompromised 
patients with multiple abscess formation, regardless 
of a positive blood culture result consistent with the 

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