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RESEARCH ARTICLE

Nocardia elegans primary iliopsoas abscess: A case report and literature review

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ABSTRACT

Nocardia species are rare causative agents of psoas abscess, more frequently occurring as part of disseminated infection. Only sporadic cases have been reported so far, with *Nocardia asteroides* and *Nocardia farcinica* being the most common causative agents. *Nocardia elegans* is an opportunistic pathogen, accounting for only 0.3–0.6% of infections caused by *Nocardia* species, usually affecting the respiratory tract.

In this study, a previously healthy 74-year-old man was admitted to the University Hospital of Heraklion with fever and intense pain radiating from the lumbar region to the groin and the left thigh, increasing with movement. Imaging findings revealed a large abscess in the left iliopsoas. Blood and pus aspirate cultures yielded a pure culture of *Nocardia* that was identified by 16S rRNA sequence as *N. elegans*. The patient was successfully treated with drainage of the abscess along with administration of ceftriaxone, linezolid and trimethoprim-sulfamethoxazole. To our knowledge, this is the first report of iliopsoas abscess caused by *N. elegans*. Early, accurate diagnosis and timely treatment with drainage of the abscess and long-term administration of antimicrobial agents optimize the outcome.

KEYWORDS

Nocardia elegans, nocardiosis, iliopsoas abscess, diagnosis, treatment

INTRODUCTION

Nocardia species are aerobic actinomycetes, which are ubiquitous in the environment namely in the dust, soil, decaying vegetation and water [1]. In humans, *Nocardia* spp. cause rare opportunistic infections, ranging from localized to disseminated infections mostly affecting immunocompromised patients, particularly those with impaired cell-mediated immunity, but occasionally it has been reported in immunocompetent hosts [2, 3]. Nocardiosis has been increasingly reported in recent years due to the improved laboratory diagnostic and identification methods and the increasing numbers of immunocompromised patients. Among the clinically significant species *Nocardia asteroides, Nocardia cyriacigeorgica, Nocardia brasiliensis, Nocardia farcinica, Nocardia abscessus, Nocardia nova, Nocardia transvalensis* and *Nocardia otitidiscaviarum* are the most common [1]. *Nocardia elegans* is rarely encountered and accounts for only 0.3–0.6% of infections caused by *Nocardia* species [4].

We herein report a case of iliopsoas abscess (IPA) caused by *N. elegans* in an immunocompetent patient and review the reported cases of nocardial psoas abscesses and those of *N. elegans* infection.

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CASE REPORT

A previously healthy 74-year-old man was admitted to the Emergency Department at University Hospital of Heraklion with a 15-day history of intense pain radiating from the lumbar region to the groin and the left thigh, increasing with movement. Over the past few days he also had fever (up to 38.7 °C), chills and sweats. His past medical history was unremarkable and he denied previous trauma, skin infection, recent invasive procedures, bowel or bladder symptoms.

On admission, his pulse rate was 70 bpm, temperature was 38.6 °C, blood pressure was 165/73 mmHg, respiratory rate was 23 breaths/min and oxygen saturation was 96% on room air. On physical examination he had tenderness to palpation over the left buttock, and pain upon extension and internal rotation of the left hip.

Laboratory tests showed a leucocytosis of 20.3×10^9/L (neutrophils 86.9%), mild anemia (hemoglobin 9.8 g dL^{-1}), elevated erythrocyte sedimentation rate of 118 mm h^{-1} (normal: < 25 mm h^{-1}), and high C-reactive protein level of 14 mg dL^{-1} (normal: < 0.5 mg dL^{-1}). The rest of the tests including workup for immunodeficiency, cancer, HIV or other systemic illness were negative.

An abdominal computed tomography (CT) scan with intravenous (IV) contrast and magneting resonance imaging (MRI) revealed a large multilocular abscess 10.5 × 8 × 4.5 cm involving the left iliopsoas. At the time of admission, two sets of blood cultures were taken. Empiric antibiotic therapy was initiated pending culture results with intravenous ceftriaxone (1 g/12 h), linezolid (600 mg/12 h) and metronidazole (500 mg/8 h). A CT-guided percutaneous drainage of the abscess was performed yielding 50 mL of purulent material, and a drain catheter was placed in the abscess cavity (Fig. 1). The pus was sent to the microbiology laboratory for analysis. The Gram-stained smear of the exudate showed polymorphonuclear leucocytes and Gram-positive fine, branching filaments, with a tendency to fragment into coccoid and bacillary forms, which were partially acid fast in Kinyoun staining. Blood cultures turned positive at 109.7 and 82.1 h and pus cultures after 72 h of incubation on 5% sheep blood and on chocolate agar plates, yielded pure growth of small white colonies, phenotypically and microscopically consistent with *Nocardia* species. The isolate was identified by matrix-assisted laser desorption/ionization time of flight mass spectrometry (MALDI-TOF MS) (Bio-Mérieux, Marcy L' Etoile, France; version 3.2), as *Nocardia veterana* (confidence level of 99.9%).

We performed a double strand Sanger sequencing of a PCR product of the 16S rRNA gene generated with universal primers 27F (5′-AGAGTTTGATCMTGGCTC-3′) and 1492R (5′- TACGGYTACCTTGTTACGACTT- 3′) [5]. The sequence chromatograms were carefully evaluated for possible multiple copies of the 16S rRNA gene with dissimilar nucleotide sequences and the derived nucleotide sequence was aligned against the publicly available sequences of the database (www.ncbi.nlm.nih.gov) using the BLAST tool. Based on the 16S rDNA sequence the isolates are grouped into the *N. nova* complex comprising *N. nova*, *N. elegans*, *N. veterana*, *Nocardia kruczakiae*, and *Nocardia africana*. According to the Clinical and Laboratory Standards Institute (CLSI) recommendations depicted in document MM18-A, a sequence similarity equal to or greater than 99.6% (with greater than 0.4% separation between different species) is necessary for the identification of *Nocardia* isolates to the species level [6]. Based on the 16S rDNA sequence the identity of our isolates with *N. elegans* was 99.76% whilst the identity score with *N. veterana* was 99.36%, confirming the identification of our isolates as *N. elegans*. The sequence was submitted to the NCBI Genbank and was assigned the number ON930001.1.

The antimicrobial susceptibility testing was performed by Etest method and the results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI)

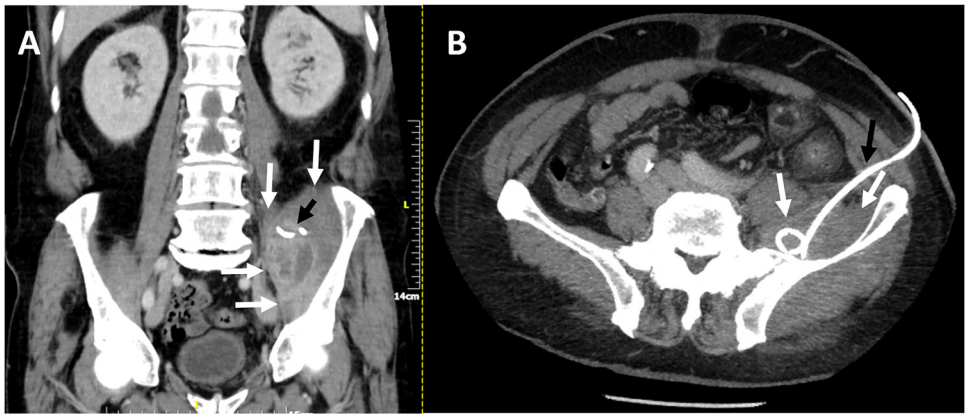

Fig. 1. Contrast-enhanced abdominal CT. A. Coronal plane reconstruction depicts an ovoid lesion at the left lower quadrant with thick enhancing peripheral walls, internal septae containing a high attenuation liquid, representing an abscess cavity with pus (white arrows). The tip of the pig-tail drainage catheter is visible at the upper part of the cavity (black arrow). B. Axial plane shows that the abscess cavity is developed posteriorly to the left psoas muscle, involving specially the left iliac and iliopsoas muscles (white arrows). The trajectory and insertion of the pig-tail drainage tube in the cavity are also figured (black arrow)

guidelines [7]. The organism was susceptible to ampicillin (MIC, 0.5 μg mL^{-1}), amoxicillin/clavulanate (MIC, 6 μg mL^{-1}), cefotaxime (MIC, 1 μg mL^{-1}), ceftriaxone (MIC, 1 μg mL^{-1}), cefepime (MIC, 0.5 μg mL^{-1}), imipenem (MIC, 0.047 μg mL^{-1}), clarithromycin (MIC, 0.38 μg mL^{-1}), amikacin (MIC, 1 μg mL^{-1}), trimethoprim-sulfamethoxazole (MIC, 0.047 μg mL^{-1}), linezolid (MIC, 0.5 μg mL^{-1}), and tigecycline (MIC, 0.75 μg mL^{-1}), intermediate to gentamicin (MIC, 8 μg mL^{-1}), minocycline (MIC, 4 μg mL^{-1}), moxifloxacin (MIC, 1.5 μg mL^{-1}), and resistant to tobramycin (MIC, 24 μg mL^{-1}), doxycycline (MIC, 6 μg mL^{-1}), and ciprofloxacin (MIC, 4 μg mL^{-1}). Once susceptibility results were available, metronidazole and linezolid were discontinued. The antibiotics were switched to trimethoprim-sulfamethoxazole (160 mg/800 mg every 12 h). Under treatment (drainage + antibiotics) the patient became afebrile, CRP decreased to 0.31 mg dL^{-1}, and leucocyte count to 6.63 × 10^9/L. The amount of drainage from the catheter decreased over the following days and it was removed after 31 days of use. Follow-up CT on day 42 after pus drainage showed remarkable shrinkage of the abscess. CT of thorax and MRI of the head did not reveal any other foci of infection. The patient was discharged from the hospital on day 46, in good clinical condition on oral trimethoprim-sulfamethoxazole. Antibiotic treatment duration was 5 months. A follow-up CT performed 12 months after discharge showed the complete resolution of the infection.

DISCUSSION

Iliopsoas abscess (IPA) is a rare condition, classified as primary or secondary. Primary IPA occurs due to the haematogenous or lymphatic spread of a causative organism from an occult source in the body and secondary occurs as a result of the direct extension of infection from adjacent organs [8]. The most common pathogen in a primary IPA is *Staphylococcus aureus* with other pathogens being *Streptococcus* spp., *Escherichia coli, Proteus, Pasteurella multocida*, *Mycobacterium tuberculosis*, *Bacteroides* spp., *Clostridium* spp., *Yersinia enterocolitica*, and *Klebsiella* [8]. IPA due to nocardiae is uncommon. Only 14 cases have been identified over the past 30 years [9–21, present case], and only three of them are primary IPA [13, 19, present case]. Our case is the first primary IPA caused by *Nocardia* described in Greece. The demographic and clinical characteristics of the patients who presented with nocardial psoas abscess are summarized in Table 1. The mean age of patients was 53 ± 14.5 years (range, 27–78 years). A male predominance was observed (1.8:1). Most patients (64.3%) had psoas abscess as part of disseminated nocardial infection, more frequently occuring via haematogenous spread from the lungs or other primary sites of infection. Pulmonary involvement was present in 21.4% of these patients. Nine patients (64.3%) were immunocompromised having underlying comorbidities predisposing to nocardiosis, namely renal transplantation, haematologic malignancies, long-term corticosteroid or intensive immunosuppressive therapy, acquired immunodeficiency syndrome, lupus nephritis, chronic hepatic disease or diabetes mellitus. Of importance, *N. asteroides* and *N. farcinica* were most frequently identified in five patients each. *N. nova, Nocardia beijingensis* and *N. elegans* were isolated only once.

N. elegans was first isolated in 2005 from the sputum of a patient with pulmonary infection [22]. Among the 16 cases of human infections caused by *N. elegans* reported to date [4, 22–35, present case] (Table 2), nine (56.3%) were associated with respiratory infections [22–26, 28, 32–34]. Five cases showed disseminated infection involving lungs, brain, eye, and skin. In two occasions *N. elegans* was the causative agent of purulent arthritis and IPA, respectively.

The mean age of patients was 52.9 ± 19.2 years (range, 12–74 years). A slight male predominance was observed (1.4:1). Japan, China, Korea, and Taiwan are the Asian countries with the highest record of *N. elegans* infections (75%). Of the 13 infected patients with available data, 84.6% had identifiable underlying risk factors. Factors predisposing to infection included kidney and lung transplantation, autoimmune disorders under steroids and immunosuppressants, hemopoietic stem cell transplantation (HSCT), diabetes mellitus and cystic fibrosis.

The accurate identification of *Nocardia* isolates to the species level is important because different species vary in their susceptibility to antimicrobials. In that context, knowing the species we could predict the antimicrobial susceptibility and implement the appropriate empirical treatment. The routine identification of *Nocardia* strains by conventional phenotypical and biochemical methods is a laborious, time-consuming process and insufficient to precisely distinguish clinical strains. MALDI-TOF has been identified to be a good choice for rapid, reliable, inexpensive, accurate identification of *Nocardia* to the species level [36, 37]. However, rare and novel species are not included in their database. This is also the present case, in which the isolate was misidentified as *N. veterana*. Molecular methodologies, such as specific gene sequencing (16S rRNA, *gyrB*, *secA1*, *hsp65* and *rpoB*) are considered to be the most accurate methods for definitive identification of *Nocardia* species [38].

The susceptibility pattern noted among *N. elegans* isolates was characterized by susceptibility to trimethoprim-sulfamethoxazole (91.7%), clarithromycin (100%), linezolid (100%), tigecycline (100%), imipenem (90%), cefepime (83.3%), and amikacin (75%) and resistance to ciprofloxacin (90%), tobramycin (87.5%), and amoxicillin-clavulanate (85.7%).

A combination of the appropriate antimicrobial therapy and drainage is required to improve the outcomes in individuals with IPA abscess, as in our patient. Patients with psoas abscess caused by *Nocardia* species underwent surgical or percutaneous drainage of the abscess along with antimicrobial therapy, and the outcome was favourable. Trimethoprim-sulfamethoxazole monotherapy is considered to be the treatment of choice for infections by *N. elegans*. Linezolid can also be used as monotherapy because of its activity

Table 1. Demographic and clinical characteristics of patients with psoas abscess caused by *Nocardia* species

Ref no.	Year	Age/ Gender	Clinical manifestation	Underlying diseases/ risk factors	Cultured isolates	Treatment	Outcome
[9]	1991	45/F*	Cerebral, perinephric, right iliopsoas and subcutaneous abscesses	T-cell leukemia, Thrombocytopenia, Steroid treatment	*Nocardia farcinica*	MINO, AN, SXT	Cured
[10]	1994	45/F	Perinephric and psoas abscess	Renal transplant recipient, Immunosuppressive therapy	*Nocardia asteroides*	Surgical drainage CIP, FUR	Cured
[11]	2002	64/M	Granulomatous pneumonitis, psoas abscess, diskitis, osteomyelitis	Waldenstrom macroglobulinemia	*Nocardia asteroides*	Percutaneous drainage SXT	Cured
[12]	2002	54/M	Spondylodiscitis, bilateral psoas abscesses, cerebral abscess, epidural abscess	Chronic liver disease, hypertension	*Nocardia farcinica*	Surgical drainage CIP, SUL, AN, TMP, MINO, IMI	Cured
[13]	2003	42/M	Left psoas abscess	None	*Nocardia farcinica*	Percutaneous drainage SXT	Cured
[14]	2007	27/F	Spondylodiscitis, psoas abscess	Renal insufficiency	*Nocardia nova*	Surgical drainage IMI, E, AMX	Improved
[15]	2007	46/M	Bilateral iliopsoas abscesses	None	*Nocardia asteroides*	Surgical drainage IMI, AN, RA, LIN	Cured
[16]	2008	56/M	Right psoas and cerebral abscess	None	*Nocardia asteroides*	Percutaneous drainage CTX, SXT	Cured
[17]	2008	32/M	Pnemonitis, soft tissue abscesses, left psoas abscess	AIDS	*Nocardia asteroides*	Percutaneous drainage SXT, AN, IMI	Cured
[18]	2011	61/F	Pulmonary and psoas abscess	Lupus nephritis, Corticosteroid treatment	*Nocardia farcinica*	Percutaneous drainage SXT, CRO, CIP	Cured
[19]	2013	60/F	Psoas abscess	None	*Nocardia* spp.	SXT	Improved
[20]	2015	58/M	Left psoas abscess	Renal transplant recipient, Immunosuppressive therapy	*Nocardia beijingensis*	Percutaneous drainage SXT, IMI	Cured
[21]	2019	78/M	Left psoas and neck abscess	Renal insufficiency, Diabetes mellitus	*Nocardia farcinica, Pseudomonas aeruginosa*	Percutaneous drainage LIN, CIP, SXT	Cured
Present	2022	74/M	Left psoas abscess	None	*Nocardia elegans*	Percutaneous drainage CRO, LIN, SXT	Cured

*F, female; M, male; NR, not reported; SXT, sulphamethoxazole/trimethoprim; AN, amikacin; MINO, minocycline; CIP, ciprofloxacin; FUR, cefuroxime; SUL, sulfadiazine; TMP, trimethoprim; IMI, imipenem; E, erythromycin; AMX, amoxicillin; RA, rifampicin; LIN, linezolid; CTX, cefotaxime; CRO, ceftriaxone.

and efficacy via oral route and because it achieves high tissue concentrations. Combination therapy with imipenem and amikacin has been also used [26, 28]. The optimal duration of therapy is still uncertain, but prolonged treatment is recommended to prevent relapses [39].

In our review, the outcome was specified in 13 patients, 1 of whom died because of delayed diagnosis, resulting in an overall mortality rate of 7.1% [31]. Delays in diagnosis and inappropriate treatment could result in fatal outcome.

In conclusion, we reported a rare case of primary IPA caused by *N. elegans* in an immunocompetent patient, successfully treated with the appropriate antimicrobials along with drainage of the abscess. Early, accurate diagnosis and timely treatment optimize the outcome.

Table 2. Cases of *Nocardia elegans* infections reported in the literature

Ref. no.	Year of isolation	Country of origin	Age (years)/ gender	Clinical manifestation	Underlying diseases/ Risk factors	Site of isolation	Treatment	Outcome
[22]	2005	Germany	NR	Pulmonary infection	NR	Sputum	NR	NR
[23]	2006	Japan	46/F*	Bronchitis	NR	Sputum	NR	NR
[24]	2007	Taiwan	51/M	Pneumonia	Dermatomyositis	Sputum	SXT	Improved
[25]	2008	Spain	26/F	Pulmonary infection	Cystic fibrosis	Sputum	MERO, TOB, SXT	Improved
[26]	2008	Korea	39/M	Lung abscess	kidney transplant recipient, immunosuppressive therapy	Purulent aspirate	SXT, AN, IMI, AMC	Cured
[27]	2012	Japan	66/F	Arthritis	NR	Pus	Bursectomy	Improved
[28]	2014	Japan	73/M	Pulmonary infection	Still's disease, immunosuppressive therapy	Sputum	IMI, AN	Improved
[29]	2014	Japan	69/M	Disseminated nocardiosis Pneumonia and brain abscess	Systemic lupus erythematosus, immunosuppressive therapy	Sputum, Brain biopsy specimen	MERO, AN, SXT, CH	Improved
[4]	2017	Japan	72/M	Disseminated nocardiosis pneumonia, endophthalmitis and abdominal skin abscess	Rheumatoid arthritis, immunosuppressive therapy	Vitreous fluid, pus from the abscess	Vitrectomy SXT, IMI, MINO, CH	Improved
[30]	2018	China	62/F	Disseminated nocardiosis Pulmonary and cutaneous infection	Diabetes mellitus	Sputum, skin biopsy specimens	P, FEP, SXT, DOXY	Improved
[31]	2018	Mali	12/M	Disseminated nocardiosis Pulmonary infection, brain and kidney abscesses	None	CSF, renal biopsy	Ventricular drainage PIP/TAZO, AN, IMI, CIP	Died
[32]	2018	Japan	57/F	Pulmonary infection	Systemic lupus erythematosus, immunosuppressive therapy	BAL	SXT	Improved
[33]	2021	Japan	34/M	Subcostal abscesses	HSCT immunosuppressive therapy	Purulent aspirate	SXT, DORI, CH	Cured
[34]	2022	Japan	69/F	Pulmonary infection	Renal transplant, immunosuppressive therapy	BAL	AM/SUL, SXT	Improved
[35]	2022	Japan	53/M	Disseminated nocardiosis Pneumonia and brain abscess	Lung transplant, immunosuppressive therapy	BAL, brain purulent aspirate	Abscess drainage, SXT, MERO, AN, CRO	Improved
Present case	2022	Greece	74/M	Iliopsoas abscess	None	Purulent aspirate	CRO, LIN, SXT	Cured

*F, female; M, male; NR, not reported; SXT, sulphamethoxazole/trimethoprim; MERO, meropenem; TOB, tobramycin; IMI, imipenem; AN, amikacin; CH, clarithromycin; MINO, minocycline; P, penicillin; FEP, cefepime; DOXY, doxycycline; PIP/TAZO, piperacillin/tazobactam; CIP, ciprofloxacin; DORI, doripenem; AM/SUL, ampicillin/sulbactam; CRO, ceftriaxone; LIN, linezolid.

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Ethical statement: Written informed consent was obtained from the patient for publication of this case report.

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