Nocardia abscessus-related intracranial aneurysm of the internal carotid artery with associated brain abscess: A case report and review of the literature

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Summary Nocardia infections primarily begin in the lungs and spread hematogenously to other sites in the body. Thus, a Nocardia brain abscess is not a completely uncommon occurrence. However, a Nocardia brain abscess complicated by a middle cerebral artery and infectious intracranial aneurysm is a very rare clinical entity. We present a case of an infectious intracranial aneurysm with an associated Nocardia brain abscess that required surgical intervention and resection. The patient was an immunocompetent 60-year-old male who presented with a chief complaint of headache and was found to have an infected intracranial aneurysm and cerebral abscess. He underwent drainage of the abscess with subsequent resection of the infected aneurysm. Cultures from both the blood vessel and brain tissue grew Nocardia abscessus. He was successfully treated with 6 weeks of ceftriaxone and high-dose trimethoprim–sulfamethoxazole. Infectious intracranial aneurysms of the brain caused by Nocardia are rare occurrences, and only a single previous case has been described in the literature. The outcomes of this condition can be catastrophic if it is not treated with a combination of surgery and intravenous antibiotics. The guidelines for the management of this infection are not well defined at this time.

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Introduction

*Nocardia* is a gram-positive, strictly aerobic bacteria and that causes at least six forms of disease in humans that include pulmonary, systemic, extrapulmonary, cutaneous, and central nervous system (CNS) nocardioses [1]. CNS nocardiosis is usually secondary to lung or systemic nocardiosis, but cases of primary CNS infections have been found, and brain abscesses are the characteristic lesions of this type of infection [1,2]. Much like CNS nocardiosis, infectious intracranial aneurysms are rare and are more closely associated with patients who are immunocompromised or have infective endocarditis [3]. Thus, the occurrence of both an infectious intracranial aneurysm and a brain abscess is very rare, and there is only a single case of documented *Nocardia*-associated aneurysm in the literature prior to this case [4]. We present a case of an immunocompetent 60-year-old male with an intracranial *Nocardia* aneurysm and associated *Nocardia* brain abscess who required surgical intervention and resection.

Case report

A 60-year-old male with a benign past medical history presented with headaches, fatigue, memory loss, and behavioral abnormalities for 2–3 weeks before admission. The temporal headaches were worsening significantly with no associated fever or chills. The patient was a relatively healthy male who lived at home and did not drink, smoke or use drugs. His travel history was unremarkable. In a recent physical performed by his primary care physicians, no evidence of any obvious underlying disease processes, such as cancer, diabetes or HIV, was found. A review of systems was negative with the exception of persistent headaches. On physical exam, his vital signs were stable, his temperature was 97.2 °F, blood pressure was 130/70, and his pulse 88 beats per minute and he had no neurological deficits. A subsequent CT scan revealed an abscess in the brain.

MRI revealed a ring-enhancing lesion and a possible abscess next to the aneurysm (Fig. 1). CT angiogram revealed a clearly outlined internal carotid aneurysm (Fig. 2). His laboratory data included a white blood cell count of $4.0 \times 10^9$ per liter, hemoglobin and hematocrit levels of 14 g/dl and 44%, respectively, and a platelet count of $257 \times 10^9$ per liter. A CD4 count and IgG were normal, and blood cultures were negative. An echocardiogram and chest X-ray were normal. He underwent a stereotactic aspiration of the abscess, which grew *Nocardia abscessus*. The identification and confirmation of the pathogen was performed using the 16s rRNA full sequencing method. The pathogen was susceptible to the following antimicrobial agents: cefotaxime, ceftriaxone, imipenem, amikacin, and sulfonamides. With a diagnosis of a primary CNS *Nocardia* infection, he was treated with intravenous injections of ceftriaxone (2 g IV every 12 h) for a total period of 4 weeks but did not improve and continued to experience headaches without neurological deficits. A repeated MRI did not reveal any worsening of the abscess, but because the patient was not clinically improving and still experiencing headaches, fatigue and memory loss, he underwent drainage of the

![Figure 1](image1.png)  MRI illustrating a ring-enhancing abscess.

![Figure 2](image2.png)  CT angiogram illustrating the aneurysm.
Discussion

Nocardia are ubiquitous, soil-borne organisms that are most commonly introduced into the body via the inhalation of airborne conidia from the environment. The bacteria can cause localized or disseminated infections, and the lungs are the most common location of primary infection. CNS nocardiosis presents with non-specific symptoms and may progress rapidly or gradually. Patients may present with signs of increased intracranial pressure such as headache, nausea, confusion and seizures [5]. Most frequently, the disease progression is gradual, and neurological deficits present over a broad range of time. CNS nocardiosis, unlike pulmonary and systemic infections, does not always result in the clinical manifestations of bacterial infection because the patient may not exhibit a fever or a shift in the blood cell differential [1].

Nocardia brain abscesses are very rare, they comprise only 1–2% of brain abscesses, and they have a high mortality rate [6]. Even as separate clinical entities, Nocardia brain abscesses and infectious intracranial aneurysms are rare and have high mortality rates [3,7]. Primary CNS nocardiosis without evidence of infection elsewhere in the body represents 8.7% of all Nocardia infections, and of these CNS infections, approximately 40% occur in immunocompetent patients [1]. In this patient, the infection appeared to be primary. There was no obvious occult site of primary infection, such as in the lung, skin, etc. We suspect that the primary site of invasion was the endovascular structure of the blood vessel with a resultant aneurysm. A retrospective study of nocardiosis cases in the El Paso area reported a rate of 58% in patients with no known predisposing factors, which may indicate that patients in this region have an elevated risk of infection [8]. In the previously mentioned study, the incidence of primary nocardia was fairly high, which may be due to the desert environment in which the patients lived. Such environments seem to be conducive to the growth of this pathogen. There have been no studies conducted in this region that have addressed the Nocardia infection risk factors or predisposing factors since 1999. Cerebral nocardiosis results in intra-parenchymal encapsulated abscesses, which constitute only 2% of all cerebral abscesses [9]. The mortality of Nocardia brain abscesses is 31%, which is higher than the mortality of other brain abscess-causing agents [10]. Infectious intracranial aneurysms represent 0.7–6.5% of all intracranial aneurysms, and the incidence of Nocardia-associated aneurysms is so rare that only a single case has been documented in the literature [4]. The mortality rates for infectious intracranial aneurysms are in the range of 80% following rupture and 30% for unruptured aneurysms [7]. The risk factors for nocardiosis include underlying conditions such as cancer, diabetes, steroid therapy and immune deficiency conditions, such as IgG deficiency.

The identification of Nocardia abscessus is based on the fact that this species is a gram-positive bacillus with branching beaded filaments and is partially acid fast. Species identification can be achieved using genus-specific 16S rRNA amplification [11]. The clinical presentation of infectious intracranial aneurysms is similar to that of other aneurysms, but the incidence of intracerebral hemorrhage is greater [7].

The main risk factor for Nocardia disseminated infection is serious immunosuppression, such as that observed in advanced HIV infection, lymphoreticular neoplasia, organ transplantation, and long-term corticosteroid use [12]. Similarly, the major risk factors for CNS nocardiosis and infectious intracranial aneurysms are immunodeficiency and infective endocarditis [5,7]. In this patient, there was no evidence of immunodeficiency; however, primary nocardiosis and actinomycosis do occur in non-immunocompetent patients as stated previously.

The diagnosis of a Nocardia-associated aneurysm and brain abscess is based on CT scans, MRI and MRA of the brain in addition to aspiration and culture of the abscess.

Ring-enhancing lesions on MRI are indicative of abscesses in the brain, and MR angiography can be used to visualize the aneurysm.

Successful treatment requires a course of antibiotics with the drainage and resection of the abscess and clipping of the aneurysm [13]. General treatment recommendations for the treatment of CNS Nocardia are limited by a lack of prospective control trials, but drugs capable of penetrating the CNS, such as TMP-SMX and ceftriaxone, have been used in the literature [13]. Surgical intervention in
combination with antimicrobials may be necessary due to the risk of the failure of medical treatment alone [3]. Additionally, patients with CNS nocardiosis should receive antimicrobial therapy for at least 12 months with clinical monitoring [14]. Due to the β-lactam susceptibility pattern of N. abscessus, a 6-week treatment with ceftriaxone and high-dose TMP-SMX proved to be sufficient for our patient. However, more data are needed to develop guidelines for the treatment of N. abscessus-associated brain abscesses and aneurysms.

In conclusion, primary brain abscesses with infectious aneurysms occur in immunocompetent hosts. Clinicians should be aware of this condition and treat it as a life-threatening condition with aggressive and rapid imaging, neurosurgical intervention and appropriate antibiotics. Because this condition is so rare, definitive recommendations regarding all aspects of the condition cannot be made. If several cases can be documented in the literature, we will be able to make further recommendations that will help clinicians manage this potentially life-threatening condition.

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**References**


