Orbital and intracranial *Nocardi*a *far*cinica infection caused by trauma to the orbit: a case report

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**Abstract**

**Background:** Localized and disseminated *Nocardi*a *far*cinica infection is frequently reported in immunocompromised patients. However, orbital nocardiosis is rare, and, to our knowledge, traumatic orbital nocardiosis that affects the brain has never been described. Here, we report a case of traumatic orbital and intracranial *N. farcinica* infection in an immunocompetent patient.

**Case presentation:** A 35-year-old man, who was immunocompetent, to the best of our knowledge and as per the absence of immunodeficiency symptoms, with orbital trauma caused by the penetration of a rotten bamboo branch developed lesions in the orbit and brain. Subsequently, he underwent debridement and received broad-spectrum antibiotic therapy, but orbital infection occurred, with drainage of pus through the sinus tract. The patient then underwent endoscope-assisted local debridement. Bacterial culture of the sinusal pus was positive for *N. farcinica*, and a combined intracranial infection had developed. The disease was treated effectively by trimethoprim-sulfamethoxazole and ceftriaxone sodium therapy. The patient remained infection free and without complications at the 14-month follow-up.

**Conclusions:** Traumatic orbital and intracranial infection caused by *N. farcinica* is a rare infectious disease, and atypical presentations easily lead to misdiagnosis. When a patient presents with an atypical orbital infection that is unresponsive to empirical broad-spectrum antibiotics, along with suspicious neurologic symptoms, *Nocardi*a infection should be considered. Identification by bacterial culture is the gold standard. Complete local debridement and appropriate antibiotic treatment are keys to the treatment of the disease.

**Keywords:** Antibiotic therapy, Endoscope, Local debridement, *Nocardi*a *far*cinica, Orbital infection, Trauma

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The patient was transferred to our hospital without obvious improvement with the abovementioned treatments. CT showed proptosis, increased density in the orbit, and a discontinuous medial wall of the orbital bone in the left eye (Fig. 1b). Magnetic resonance imaging (MRI) showed hyperintensity in the superonasal region of the left eye (Fig. 1c). An ocular examination revealed the absence of light perception, orbital swelling, ptosis, proptosis, ophthalmoplegia, absence of pupillary light reflex, and purulent discharge from the inferonasal conjunctival sinus (Fig. 2a). Fundoscopic examination revealed retinal edema and macular cherry-red spot (Fig. 2b). No obvious abnormalities were found on a general examination, there was no increase in the C-reactive protein (0.8 mg/L, normal range 0–10 mg/L), other than abnormal laboratory exams including leukocytosis (22.62 × 10^9/L, normal range 3.5–9.5 × 10^9/L) and increased neutrophils (18.81 × 10^9/L, normal range 1.8–6.3 × 10^9/L).

Pus from the conjunctival sinus was taken for culturing. Antibiotics such as ceftazidime (2 g every 12 h) and metronidazole (0.5 g every 12 h) were administered immediately. Five days after admission, the patient underwent endoscope-assisted orbitotomy. We made an incision on the sinus and exposed the deep orbital tissue through the sinus tract. To avoid the limitation of a small operating visual field, orbital abscesses and a few orbital foreign bodies were removed using an endoscope. Purulent fluid was obtained for repeated culture. Multiple incisional biopsies were performed and sent for histopathological examination. On the first postoperative day, N. farcinica was cultured from the pus of conjunctival sinus (Fig. 3 a-b). Histological examination of orbital tissues showed chronic pyogenic inflammation on the second postoperative day (Fig. 3c). The patient developed high fever and complained of headache. Laboratory examinations revealed moderate leukocytosis (16.93 × 10^9/L, normal range 3.5–9.5 × 10^9/L), increased neutrophils (14.3 × 10^9/L, normal range 1.8–6.3 × 10^9/L), and elevated C-reactive protein (30.77 mg/L, normal range 0–10 mg/L).

After 1 week of ceftazidime and metronidazole therapy and orbital surgical treatment, the patient was transferred to the infection department and immediately treated with oral trimethoprim-sulfamethoxazole (4 g every 12 h) and intravenous mannitol (25 g every 12 h). MRI of the head, chest, and abdomen showed no abnormalities. A lumbar puncture yielded clear cerebrospinal fluid.
fluid with leukocytes 480/μL (normal range 0–10/μL, 45% neutrophils and 55% lymphocytes), glucose 1.98 mol/L (normal range 2.8–4.4 mol/L), chloride 118.2 mol/L (normal range 120–132 mol/L), protein 1046 mg/L (normal range 150–450 mol/L mg/L), and a positive Pandy’s test. Five days later, antibiotic therapy with 2 g ceftriaxone sodium every 12 h was initiated. The patient responded well to the drug treatment with trimethoprim-sulfamethoxazole (4 g every 12 h) for 28 days, 20% mannitol (25 g every 12 h) for 19 days, and ceftriaxone sodium (2 g every 24 h) for 23 days, and a repeat MRI was performed 1 month postoperatively (Fig. 4a). However, blindness, ptosis, and ophthalmoplegia persisted (Fig. 4b). To prevent the recurrence of infection, the patient was advised to continue trimethoprime-sulfamethoxazole intake for 3 months. The dose in the first 2 months was 4 g every 12 h and subsequently, 3.2 g every 12 h for a month. The patient remained stable over a 14-month follow-up period.

Discussion and conclusions

*N. farcinica* is an aerobic, gram-positive, filamentous, ubiquitous, soilborne, and weakly acid-fast bacteria [3, 4]. *N. farcinica* infections are usually acquired by direct inhalation of contaminated particles from soil or water; however, these infections are also reported to occur after traumatic injury [5, 6]. Misdiagnosis and mistreatment of *N. farcinica* infection can cause severe damage and even death, because *Nocardia* species can disseminate and are resistant to antibiotics.

Nocardiosis often affects immunocompromised individuals. The patient in this case had no obvious immunodeficiency and was infected due to traumatic orbital injury. Infection by direct orbital injury is rare, as...
most injury-mediated infections occur in the limbs and skin [2]. According to Torres et al., a literature review of nocardiosis showed that traumatic injuries accounted for only 10% of infections [1]. Another review showed that N. farcinica accounted for 5% of all nocardiosis [6]. Additionally, concurrent orbital and intracranial N. farcinica infections due to injury have not been previously reported.

Clinical manifestations of orbital infection usually involve periorbital edema, crepitus, ophthalmoplegia, exophthalmos, chemosis, and visual loss [2, 7]. The case we have reported here had no other specific features, and the symptoms mentioned above are similar to those for subacute local infection. However, the infection in our patient also involved the brain, and the patient experienced high fever and headache. Nocardiosis often disseminates hematogenously to distant organs, such as the lungs, kidneys, joints, and bones [1]. In our patient, the infection did not spread to other organs, possibly because he was young and immunocompetent.

Thus far, isolation and identification of Nocardioid strains is the only reliable diagnostic method. Nocardioid species are strictly aerobic and grow slowly at 35 °C in standard culture medium. Hence, it is important to inform the microbiological laboratory that nocardiosis with soil/environmentally contaminated penetrating traumas should be considered, even among immunocompetent patients, to facilitate the identification of Nocardioid species. N. farcinica grew from cultures of conjunctival pus samples from our patient. Bacteria were not detected in cultures from other body fluids, including orbital abscess secretions, cerebrospinal fluid, and blood, most likely due to the antibiotic therapy. Microscopic examination of Nocardioid revealed that these are gram-positive, thin, branching, filamentous, bacillary, or coccoid bacteria [8]. Identification procedures include biochemical, chemotaxonomic, serological, antimicrobial susceptibility testing, and molecular methods. Molecular techniques are more rapid and precise than other methods [8]. In our case, N. farcinica presented as bacillary or coccoid forms, and bacterial identification was performed using an emerging molecular technique, namely matrix-assisted laser desorption ionization-time of flight mass spectrometry, which is a rapid, sensitive, and economical method for identifying and diagnosing microbial infections [9].

Complete local debridement and appropriate antibiotic therapy are important in the treatment of Nocardioid infections [10]. The infectious lesion was located deep within the orbit, making its exposure difficult. As such, endoscope-assisted debridement was important for excising the abscesses efficiently and accurately. Appropriate antibiotic administration is another critical factor to treat nocardiosis, and susceptibility testing is of vital importance as the susceptibility pattern of Nocardioid species is highly variable. In our case, drug susceptibility test was not performed, because this was the first case of nocardia infection in our hospital, and paper diffusion method reference standard for the drug susceptibility test on Clinical and Laboratory Standards Institute is not available. However, patients must undergo antibiotic therapy immediately after the diagnosis of N. farcinica infection. Trimethoprim-sulfamethoxazole is the first choice for the treatment of N. farcinica infections before obtaining the susceptibility-test result [1, 4]. Empiric combination therapy of trimethoprim-sulfamethoxazole and ceftriaxone is also recommended [6]. The therapy needs to be continued for several months due to the high possibility of infection recurrence, which depends on the immune status of the patient. If the central nervous system is affected, the therapy should be continued at least for 6 months. In our case, the patient was immunocompetent and was treated with antibiotic therapy for 3 months, and there was no recurrence of infection at 14-month follow-up.

In conclusion, due to the low incidence of orbital Nocardioid infections, these are not well characterized and are often not considered in an initial diagnosis. When a patient presents with an atypical orbital infection that is unresponsive to empirical broad-spectrum antibiotics, along with suspicious neurologic symptoms, Nocardioid infection should be considered. Misdiagnosis and inappropriate therapy may result in serious consequences. The present case also highlights the clinical features, diagnosis, and novel management of Nocardioid infection using endoscope-assisted local debridement. Appropriate antibiotic treatment based on susceptibility testing is another critical component of the treatment for N. farcinica infections.

Abbreviations
CT: Computed tomography; MRI: Magnetic resonance imaging

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AAW, QHX, and HFL wrote the manuscript and reported the case to the regulatory agency. YHW followed the patient regularly. All authors read and approved the final manuscript.

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