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Rhizobium radiobacter Meningitis in an Immunocompetent Child Without Neurosurgical Hardware: A Case Report

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Abstract

Rhizobium radiobacter is a soil-associated Gram-negative bacillus that rarely causes human disease. Most reported infections occur in immunocompromised individuals or in association with indwelling medical devices. Central nervous system infection is exceptionally rare, with only one previously reported case of meningitis in the literature.

We report the case of a previously healthy seven-year-old girl who presented with fever, neck stiffness, severe headache, photophobia, and transient visual and auditory hallucinations. Neuroimaging was normal. Cerebrospinal fluid analysis demonstrated neutrophilic pleocytosis consistent with bacterial meningitis. Culture identified *R. radiobacter* using the VITEK GN identification system (bioMérieux SA, France), with susceptibility to ceftazidime, cefepime, meropenem, and ciprofloxacin. The patient initially received empirical ceftriaxone, vancomycin, and dexamethasone before therapy was streamlined to ceftazidime according to culture results, resulting in rapid clinical improvement and complete recovery after 14 days of targeted treatment.

To our knowledge, this represents a rare case of *R. radiobacter* meningitis in an immunocompetent pediatric patient without neurosurgical hardware or other traditional predisposing factors, and the first reported case from Lebanon. This case expands the clinical spectrum of invasive *R. radiobacter* infection and highlights the importance of careful clinico-microbiological correlation when uncommon environmental organisms are isolated from sterile body sites.

Categories: Neurology, Internal Medicine, Infectious Disease
Keywords: bacterial meningitis, central nervous system infection, immunocompetent child, opportunistic pathogen, rhizobium radiobacter

Introduction

Rhizobium radiobacter (formerly *Agrobacterium radiobacter* and *Agrobacterium tumefaciens*) is an aerobic Gram-negative bacillus that primarily inhabits soil and plant environments. Human infections are rare and have traditionally been associated with immunocompromised hosts, indwelling vascular catheters, prosthetic material, peritoneal dialysis, or other implanted medical devices [1,2]. Reported clinical manifestations include catheter-related bloodstream infections, peritonitis, endocarditis, ocular infections, and, rarely, central nervous system involvement [1,2].

Central nervous system infection due to *R. radiobacter* is exceedingly uncommon. To date, only a single case of culture-confirmed meningitis has been reported in the literature, occurring in an adult patient with an intrathecal catheter and morphine pump [1]. Rare additional reports describe cerebral abscess formation, primarily in immunocompromised individuals [3]. Because *R. radiobacter* is an environmental organism, its isolation from clinical specimens may occasionally represent contamination rather than true infection, as demonstrated by previously reported pseudo-outbreaks linked to contaminated laboratory equipment and specimen-processing materials [4,5]. Consequently, correlation with clinical presentation and cerebrospinal fluid (CSF) findings is essential when interpreting positive cultures.

We report a case of culture-confirmed *R. radiobacter* meningitis in an immunocompetent child without neurosurgical hardware, immunodeficiency, or other recognized predisposing factors. To our knowledge, this represents a rare case of *R. radiobacter* meningitis and may be the first reported case in an immunocompetent pediatric patient without central nervous system instrumentation.

Case Presentation

A previously healthy seven-year-old girl, with a body mass index of 14.3 kg/m ^{2}, presented in October 2025 to the emergency department with a two-day history of fever and neck stiffness. She lived in South Lebanon and had frequent close contact with household cats, including outdoor cats. The presentation occurred in October; however, no seasonal association with infection could be established, and the timing of presentation is reported for completeness without implying a causal or epidemiological association with the season. She was born by cesarean section; had no significant past medical history, no personal or family history suggestive of immunodeficiency, and no history of recurrent otitis media or recurrent infections, and was reported to be fully vaccinated for age. She had no history of ventriculoperitoneal shunt placement, central venous catheter insertion, or other indwelling medical devices.

The patient had a history of allergy and received cough and allergy medications before admission, reported by the family as Sinecod (butamirate-containing antitussive medication) and Frenaler (desloratadine, an antiallergic medication). There was no reported history of corticosteroid use prior to admission.

Two days before presentation, the patient developed a fever that reached 38.5°C and was partially responsive to antipyretic therapy with ibuprofen and paracetamol. On the second day of illness, she developed neck stiffness, prompting her family to seek medical attention. During hospitalization, she developed a severe generalized headache associated with photophobia. She also experienced visual and auditory hallucinations. There was no history of vomiting, confusion, decreased level of consciousness, seizures, limb weakness, abnormal gait, diplopia, blurred vision, or facial asymmetry. Her Glasgow Coma Scale score remained 15/15 [6], and no focal neurological deficits were documented.

Regarding possible portals of entry, the patient had regular close contact with cats and frequently played with them, fed them by hand, held them tightly, and allowed them to lick her. The family could not confirm a definite cat scratch or bite; however, they reported that a minor scratch or small superficial wound was possible. No overt infected wound, abscess, cellulitis, or obvious skin lesion was documented at presentation. No exposure to untreated or contaminated water, ingestion of wild or unidentified plants, or other unusual environmental activities was reported. Furthermore, a detailed history obtained from the patient's mother revealed that the child had not stayed in a refugee camp, school shelter, or tent and had not sustained any trauma, wounds, or other injuries related to the war or recent attacks before the onset of illness. Overall, no definite portal of entry was identified, although minor cutaneous inoculation related to cat exposure could not be completely excluded.

On admission, laboratory investigations showed a peripheral white blood cell count of 8.11×10^9/L, with 75% neutrophils and 19% lymphocytes. No electrolyte disturbances were identified. The C-reactive protein level was 1.8 mg/L. Neuroimaging was performed and was unremarkable. Computed tomography of the brain showed no acute intracranial abnormality, and magnetic resonance imaging of the brain was normal.

Given the clinical suspicion of meningitis, a lumbar puncture was performed before the initiation of antimicrobial therapy. The opening pressure was elevated at 30 cm H_2O (normal range 10-20 cm H_2O). CSF fluid was cloudy and turbid. CSF analysis revealed pleocytosis, with a white blood cell count of 308 cells/μL (normal range 0-5 cells/μL) with a neutrophilic predominance, consisting of 80% neutrophils and 20 % lymphocytes. The CSF red blood cell count was 1,000 cells/μL (normal range 0 cells/μL). The high red blood cell count in our patient's CSF was due to a traumatic tap, as blood cleared in subsequent tubes. CSF glucose was 53 mg/dL (normal range 45-80 mg/dL), and protein was 57 mg/dL (normal range 15-45 mg/dL). Table *1* summarizes the blood and CSF laboratory findings.

Investigation	Patient result	Reference value
Peripheral blood white blood cell count	8.11 × 10^9/L	5-10 × 10^9/L
Peripheral blood neutrophils	75%	40-70%
Peripheral blood lymphocytes	19%	20-40%
C-reactive protein	1.8 mg/L	1-5 mg/L
Cerebrospinal fluid opening pressure	30 cm H_2O	10-20 cm H_2O
Cerebrospinal fluid white blood cells	308 cells/µL	0-5 cells/µL
Cerebrospinal fluid neutrophils	80%	Not normally predominant
Cerebrospinal fluid lymphocytes	20%	Not specified
Cerebrospinal fluid red blood cells	1,000 cells/µL	0 cells/µL
Cerebrospinal fluid glucose	53 mg/dL	45-80 mg/dL
Cerebrospinal fluid protein	57 mg/dL	15-45 mg/dL

TABLE 1: Laboratory findings at admission, including peripheral blood and cerebrospinal fluid analysis

Initial lumbar puncture processing revealed bacterial growth in the thioglycolate enrichment broth after 24 hours of aerobic incubation at 37°C. Subculture on MacConkey agar from the enrichment tube yielded non-lactose-fermenting colonies that appeared pale and translucent after 24 hours of incubation at 37°C. Gram staining demonstrated Gram-negative, pleomorphic rods. The isolate was oxidase-positive and catalase-positive on preliminary biochemical testing, features that aid in its differentiation from Enterobacterales. Definitive identification was performed using the VITEK automated system (bioMérieux SA, France) with the GN identification card, which identified the organism as *R. Radiobacter* (formerly *A. Radiobacter*) with a probability of >98%. No additional confirmatory identification method, such as matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF) mass spectrometry or 16S ribosomal RNA (rRNA) gene sequencing, was performed.

Antimicrobial susceptibility patterns are variable; therefore, treatment decisions should be guided by isolate-specific susceptibility testing. Therefore, susceptibility testing was confirmed on Mueller-Hinton agar by disk diffusion using key antimicrobial agents including meropenem, ciprofloxacin, cefepime, and ceftazidime. The isolate demonstrated susceptibility to all. Minimum inhibitory concentration values were not available.

Blood cultures were obtained before the initiation of antimicrobial therapy. Two sets of blood cultures were collected, and both remained negative. Total immunoglobulin levels were within normal limits, and HIV testing was negative. Based on her clinical history and available investigations, she was considered immunocompetent; however, no additional formal immunologic investigations were performed.

The patient was initially started empirically on intravenous (IV) ceftriaxone 1.25 g twice daily, IV vancomycin at a dose of 375 mg every six hours, and adjunctive IV dexamethasone at a dose of 4 mg twice daily, which were continued for five days. After the CSF culture results showed susceptibility to ceftazidime, the patient was shifted from ceftriaxone to ceftazidime at a dose of 750 mg IV every eight hours (50 mg/kg/dose), and vancomycin and dexamethasone were discontinued.

Following initiation of ceftazidime on day 5, the patient showed rapid clinical improvement, with resolution of headache within 24 hours. She completed a course of 14 days of ceftazidime and demonstrated favorable clinical recovery. Repeat CSF cultures were not performed because of financial clearance limitations.

This case represents culture-confirmed Rhizobium species meningitis in a previously healthy child without a ventriculoperitoneal shunt, central venous catheter, or other indwelling medical device, with neutrophilic CSF pleocytosis and favorable clinical response to culture-directed ceftazidime therapy.

Discussion

R. radiobacter (formerly *A. radiobacter* and *A. tumefaciens*) is an aerobic, motile, non-spore-forming Gram-negative bacillus widely distributed in soil and plant environments, where it is recognized for its role in

plant-associated microbial ecosystems [2,7]. Human infection is uncommon and has traditionally been associated with immunocompromised hosts, indwelling vascular catheters, peritoneal dialysis, prosthetic devices, and other implanted foreign material because of its notable ability to adhere to synthetic surfaces and form biofilms [2,7]. Reported clinical manifestations include catheter-related bloodstream infections, peritonitis, endocarditis, ocular infections, and, rarely, central nervous system involvement [2,7].

Central nervous system infection caused by *R. radiobacter* is exceptionally rare. To date, only one case of culture-confirmed meningitis has been reported in the literature, involving an adult patient with an intrathecal morphine pump and catheter [1]. The clinical characteristics, treatment regimens, and outcomes of our patient and the case reported by Laffut et al. are compared in Table *2*.

Feature	Laffut et al. [1]	Present case
Patient	Adult (48-year-old man)	Child (7-year-old girl)
Immune status	Not specified (associated risk factors)	Immunocompetent
Neurosurgical hardware	Intrathecal catheter and morphine pump	None
Other foreign body or medical device	Present	Absent
Clinical presentation	Meningitis	Meningitis
Microbiological ident	CSF culture	CSF culture (VITEK GN)
Treatment	Culture-guided antibiotics	Empirical ceftriaxone followed by ceftazidime
Outcome	Recovered	Recovered
Distinguishing feature	First reported adult case of *R. radiobacter* meningitis associated with intrathecal hardware	Possible first reported pediatric immunocompetent case without CNS hardware (Lebanon)

TABLE 2: Comparison of clinical characteristics between the present case and the previously reported case of Rhizobium (Agrobacterium) radiobacter meningitis

CSF: cerebrospinal fluid; CNS: central nervous system

In addition, rare cases of cerebral abscess have been described, primarily in immunocompromised individuals [3]. In contrast, our patient was a previously healthy child without neurosurgical instrumentation, implanted devices, immunodeficiency, or other recognized predisposing factors. This presentation broadens the clinical spectrum of invasive *R. radiobacter* infection and suggests that meningitis may occur even in immunocompetent pediatric patients.

The route of acquisition in our patient remains uncertain. *R. radiobacter* is an environmental organism that is ubiquitously present in soil and vegetation [2,7]. The patient frequently played outdoors and had regular contact with household and outdoor cats. Although no definite portal of entry was identified and no confirmed cat scratch or bite was documented, minor unnoticed cutaneous inoculation related to environmental exposure cannot be excluded. Nevertheless, the exact source of infection remains speculative.

An important challenge when *R. radiobacter* is isolated from clinical specimens is differentiating true infection from contamination. Previous reports have documented pseudo-outbreaks linked to contaminated laboratory saline dispensers and specimen-processing materials, highlighting the potential for false-positive microbiological results [4,5]. Several findings support true infection in our patient. She presented with a compatible clinical syndrome characterized by fever, neck stiffness, severe headache, and photophobia, accompanied by CSF findings consistent with bacterial meningitis. However, bacterial growth was initially detected in thioglycolate enrichment broth, and identification was performed solely using the VITEK GN automated system, with a probability exceeding 98%. Although this finding supports the identification, automated biochemical methods may have limitations when identifying uncommon organisms. Independent confirmation using MALDI-TOF mass spectrometry or 16S rRNA gene sequencing was not performed, and repeat CSF cultures were unavailable because of financial clearance limitations. Therefore, contamination or misidentification cannot be definitively excluded. Nevertheless, the overall clinical findings and favorable response to antimicrobial therapy support the possibility of true infection, emphasizing the importance of careful clinico-microbiological correlation when interpreting uncommon environmental organisms isolated

from CSF, a normally sterile site.

The clinical presentation and neutrophilic CSF pleocytosis are compatible with bacterial meningitis, although interpretation of individual CSF parameters requires clinical context [8,9]. Empirical antimicrobial treatment is recommended promptly when bacterial meningitis is suspected, followed by adjustment according to microbiological identification and susceptibility testing [8]. Guidance for healthcare-associated Gram-negative meningitis emphasizes organism-directed treatment and consideration of infected hardware removal when applicable; however, these recommendations are not directly validated for spontaneous *R. radiobacter* meningitis in an otherwise healthy child [10].

Because *R. radiobacter* meningitis is rare, evidence-based recommendations on the optimal duration of antimicrobial therapy are lacking. Published cases have been managed with susceptibility-guided IV antibiotics combined with removal of infected neurosurgical devices when present. Therefore, treatment duration is individualized based on clinical response, CSF sterilization, and source control, often extrapolating from recommendations for healthcare-associated Gram-negative bacillary meningitis. In our patient, who presented with non-device-associated meningitis and had rapid clinical improvement after initiation of targeted therapy, a 14-day course of IV ceftazidime was completed, resulting in complete clinical recovery.

This case broadens the recognized spectrum of invasive *R. radiobacter* infection by demonstrating that culture-confirmed meningitis can occur in an immunocompetent child without neurosurgical instrumentation or other traditional risk factors. It also highlights the importance of careful clinico-microbiological correlation when uncommon environmental organisms are isolated from sterile body sites. Although *R. radiobacter* is generally regarded as an opportunistic pathogen, our case demonstrates that severe central nervous system infection can occur in the absence of traditional risk factors. To the best of our knowledge, this represents a rare case of *R. radiobacter* meningitis in an immunocompetent pediatric patient without neurosurgical hardware and the first reported case from Lebanon. This was the first isolation of *R. radiobacter* from a clinical specimen in our center. Additional reports are needed to further define the epidemiology, pathogenesis, antimicrobial susceptibility patterns, and optimal management of this rare infection.

Conclusions

This case highlights *R. radiobacter* as a potential, exceptionally rare cause of bacterial meningitis in immunocompetent pediatric patients without neurosurgical hardware or other traditional risk factors. Although the clinical presentation, CSF findings, and favorable response to targeted antimicrobial therapy support a possible pathogenic role, the absence of independent microbiological confirmation and repeat CSF cultures limits diagnostic certainty. Therefore, contamination or misidentification cannot be definitively excluded. This case emphasizes the importance of careful clinico-microbiological correlation when uncommon environmental organisms are isolated from normally sterile sites. Further reports incorporating confirmatory microbiological techniques are needed to better characterize the clinical significance, diagnostic approach, and optimal management of this rare infection.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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