

A Confirmed Case of Rat Bite Fever

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ABSTRACT

Introduction: Rat bite fever is a rare zoonotic illness that presents with nonspecific symptoms. Rapid identification and treatment are essential to reduce morbidity or mortality.

Case Presentation: A 39-year-old male presented to the emergency department with severe headache and arthralgias. His history was notable for multiple bites and scratches from pet rats. He was admitted for further evaluation after meeting systemic inflammatory response syndrome (SIRS) criteria for sepsis. A meningitis workup was unrevealing. He was treated for presumed rat bite fever with amoxicillin and discharged in improved condition. Several days later, his blood culture grew *Streptobacillus moniliformis*. His symptoms resolved with appropriate antibiotic therapy.

Discussion: Prompt recognition and management are necessary to avoid complications of rat bite fever. A thorough history is crucial to identify uncommon exposures when initial workup is unrevealing.

Conclusions: This report describes a rare, culture-confirmed case of rat bite fever. Because this disease is not nationally reportable, it may be more prevalent than currently recognized and should remain in the differential diagnosis for patients with nonspecific symptoms and known rodent exposure.

INTRODUCTION

Rat bite fever is a rare disease most commonly caused by infection with *Spirillum minus* or *Streptobacillus moniliformis*. Most cases are seen in Japan, where the causative agent is more likely to be *S minus*. In contrast, in Western countries, the causative agent is more likely to be *S moniliformis*, a nonmotile, pleomorphic, gram-negative bacillus that forms a characteristic “cotton ball” appearance on growth media.¹ Classically, transmission occurs via infected mucosal secretions from a rodent, giving the disease

its name. However, transmission can also occur through rat urine and via contaminated food or water, as well as through household pets (eg, cats and dogs) that may serve as reservoirs for the disease if exposed to an infected rodent.²

Symptoms typically arise 2 to 4 weeks following exposure and include fever, which may wax and wane for months, along with migratory polyarthralgias most commonly affecting the knees, ankles, and back.² Approximately 75% of patients develop a maculopapular rash on the extremities.^{2,3} Symptoms are thought to be due to bacteremia; however, this is difficult to confirm because the organism is challenging to culture.

The actual incidence is unknown because the causative bacteria are fastidi-

ous and difficult to grow, often respond to common antibiotic regimens prior to diagnosis, and the disease is not nationally reportable; however, a 2013 case report found that during 2000-2012, only 17 confirmed cases of rat bite fever were identified in California.⁴ The general mortality rate of untreated rat bite fever is approximately 13% and can be as high as 53% in *S moniliformis* endocarditis; therefore prompt identification and treatment are essential.^{1,4}

CASE PRESENTATION

A 39-year-old male presented to the emergency department (ED) with severe arthralgias in the bilateral shoulders, elbows, wrists, and knees, and back, as well as pain, erythema, and warmth of his right third metacarpophalangeal (MCP) joint and left second MCP joint. Approximately 1 week prior to admission, he developed diarrhea and vomiting that persisted for 24 hours and resolved

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spontaneously. Three days prior to admission, he was removing his pet rats from their cage when one of the rats scratched his back. He was unsure whether the rat bit him at that time but reported a confirmed bite approximately 4 weeks prior to admission. Within hours of being scratched, he developed diffuse arthralgias that progressively worsened until he presented to the ED.

In the ED, the patient was tachycardic (heart rate, 124 beats/min), and mildly hypertensive (systolic blood pressure, 131 mm Hg). His white blood cell count (WBC) was markedly elevated $26.5 \times 10^3/\mu\text{L}$ with a neutrophilic predominance. His C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) were elevated to 327.4 and 97, respectively. Based on his tachycardia and elevated WBC, he was admitted with sepsis after meeting systemic inflammatory response syndrome/sepsis (SIRS) criteria.

On admission, he developed a fever of 101.1°F . Physical examination was notable for tenderness to palpation in the bilateral neck, shoulders, elbows, wrists, knees, and MCP joints, along with erythema, edema, and warmth in the right third MCP joint and left second MCP joint, without associated lymphadenopathy. Several well-healed, nonerythematous scratches were noted across his left posterior flank. He was also found to have strength graded 2/5 in the left lower extremity and 1/5 in the right lower extremity. His patellar reflexes were brisk bilaterally, approaching 4+. Laboratory results were significant for a leukocytosis and elevated ESR and CRP (see Table). He subsequently developed a fever of 102.6°F several hours after admission. Head computed tomography (CT) without contrast showed no acute findings. Lumbar puncture demonstrated elevated cerebrospinal fluid (CSF) protein. Blood and CSF cultures were collected and remained negative during hospitalization. Magnetic resonance imaging of the lumbar and thoracic spine, obtained due to new-onset weakness and hyperreflexia, showed no acute findings. Testing for hepatitis A, B, C and HIV was negative.

The patient was started on vancomycin, ceftriaxone, ampicillin, acyclovir, and dexamethasone for empiric meningitis coverage. Given concern for zoonotic infection, doxycycline was also initiated. Meningitis-directed therapy was discontinued following a negative workup, and he was transitioned to oral amoxicillin. He showed clinical improvement and was discharged home in stable condition on amoxicillin 5 days after admission with a presumptive diagnosis of rat bite fever.

However, he re-presented to the ED 5 days after discharge after notification from the hospital that his blood cultures had grown a gram-negative bacterium. He reported no new symptoms aside from persistent back pain, and his physical examination and vital signs were unchanged. He was discharged the following day following repeat blood cultures and no change in antibiotic therapy after infectious disease consultation. Subsequently, his initial cultures confirmed *S moniliformis*, establishing the diagnosis of rat bite fever. Repeat blood cultures remained negative following treatment.

Table. Laboratory Values

Lab	Value	Reference Range
White blood cell count	26 500 cells/ μL	4000–11000 cells/ μL
Erythrocyte sedimentation rate	97 mm/hr	0–15 mm/hr
C-reactive protein	327.4 mg/L	<10 mg/L
Cerebrospinal fluid protein	46.9 mg/dL	15–45 mg/dL
HIV-1/HIV-2 antigen/antibody	Negative	Negative
Total anti-hepatitis A (IgG and IgM)	Negative	Negative
Total anti-hepatitis B core (IgG and IgM)	Negative	Negative
Anti-hepatitis C antibody	Negative	Negative

DISCUSSION

Rat bite fever is a rare, systemic, zoonotic illness characterized by recurring fevers and a rash that often affects the palms and soles. Transmission most commonly occurs via a rat bite; however, infection can also result from ingestion of contaminated food or water.⁵ Each year, more than 2 million animal bites occur in the United States, yet rat bites account for approximately 1% of these cases. Children younger than 5 years are most affected, and individuals who work in pet stores or conduct research with rats are also at increased risk. Following a rat bite, the estimated risk of infection is approximately 10%.²

Although limited data exist regarding the incidence in the United States, a retrospective study analyzing rat-bite injuries between 2001 and 2015 found an ED visit rate of 0.33 per 1 million individuals and a hospitalization rate of 0.20 per 1 million individuals.⁶ Another retrospective study examining *S moniliformis* cultures from 1970 to 1998 found that approximately 83% of suspected rat bite fever cases involved either a rat bite or rodent exposure.⁷ Because rat bite fever is not a nationally reportable condition, comprehensive epidemiological data remain scarce, underscoring the need for improved surveillance, standardized reporting, and increased public health awareness.

The Centers for Disease Control and Prevention (CDC) provides information on rat bite fever on its website but notes the disease is not reportable in any state and is not nationally notifiable.⁸ The CDC does not specify the reasons; however, it acknowledges that rat bite fever is rare in the United States, which may contribute to its nonreportable illness. According to the CDC, the Council of State and Territorial Epidemiologists determines the list of nationally reportable diseases, in collaboration with the CDC, including diseases for which data allow states and local agencies to tailor programs for disease control and prevention.⁹ Surveillance is increased when prevention is feasible (eg, measles) or when a disease is severe and novel (eg, acquired immunodeficiency syndrome, SARS-CoV-2).⁹ Because rat bite fever lacks a vaccine and treatment is typically highly effective, it is not prioritized for mandatory reporting.

Rat bite fever is primarily caused by infection with *S moniliformis* but may also be caused by other organisms. Notably, *S*

minus and *S notomytis* are causative agents of similar yet distinct syndromes that share the same name but are far less common in North America.^{1,7} *S moniliformis* is a pleomorphic, branching, gram-negative bacillus that is commonly found in the flora of the nasal and oropharyngeal cavities in rodents, most notably rats.^{1,7} This pathogen has multiple routes of transmission to humans, including direct exposure to rodent saliva (bites, scratches), handling infected or colonized rats (including close contact such as kissing pet rodents), or ingestion of food or water contaminated with infected rat feces (a condition known as “Haverhill fever”).¹ Given the low incidence and mortality rates of rat bite fever, there is limited research on the pathogenesis of *S moniliformis*, although immune complex deposition has been hypothesized to play a role.¹ This pathogen is known to be difficult to culture but may produce characteristic “puffball” or “cotton ball” colonies when grown in thioglycolate broth.⁴ More advanced techniques may be required for definitive identification if traditional culture methods are unsuccessful, including gas chromatography, mass spectrometry, and genetic sequencing.^{1,7}

Symptoms of rat bite fever typically develop 2 to 4 weeks after exposure. At disease onset, patients commonly experience fever, rigors, headache, nausea, vomiting, and severe myalgias.¹ The fever may recur intermittently and persist for months.² As the illness progresses, more than 50% of patients develop migratory polyarthralgias affecting both large and small joints of the extremities, particularly the knees and ankles.¹ Migratory polyarthralgia is often the most persistent feature, lasting for months or even years.

In infections caused by *Streptobacillus*, the site of the bite may appear healed with minimal or no signs of inflammation. Approximately 75% of patients develop a petechial or maculopapular rash, and some may present with tender, hemorrhagic vesicles on the extremities.² In contrast, infections due to *S minus* (spirillosis) often involve a more visibly indurated and potentially ulcerated bite site. Lymphadenopathy is more common in spirillosis than in *Streptobacillus* infections, and approximately half of patients with spirillosis develop a violaceous, red-brown macular rash.²

Diagnosis is largely clinical, based on a history of rodent exposure and characteristic findings. Laboratory evaluation may reveal leukocytosis and elevated inflammatory markers. Blood cultures may confirm *S moniliformis* infection; however, the organism is fastidious and may require specialized media.²

Patients are advised to avoid contact with rodents and practice proper hygiene, including handwashing after contact and prompt cleaning of bites or scratches. Empiric antibiotic therapy is essential, as delays in treatment increase the risk of complications. For adults, the recommended first-line treatment is intravenous (IV) penicillin G (400 000–600 000 units/day) or IV ceftriaxone 1 g daily for 7 to 10 days.¹ Once the patient improves clinically, a transition can be made to oral penicillin V 500 mg 4 times daily, ampicillin 500 mg 4 times daily, or amoxicillin 500 mg 3 times daily to complete a 14-day course.² For penicillin-allergic

patients, doxycycline 100 mg orally or intravenously twice daily is an acceptable alternative.² With timely and appropriate treatment, the prognosis for rat bite fever is excellent, highlighting the importance of early recognition and intervention.

CONCLUSIONS

This case represents a rare instance of rat bite fever. Although uncommon and difficult to culture, this condition is likely underreported and may present with delayed symptom onset of up to 4 weeks. Exposure history may not be readily elicited, and lesions are often well healed at presentation. Because the causative organisms are typically susceptible to common antibiotics (eg, penicillin, amoxicillin, doxycycline, ceftriaxone), empiric therapy may lead to rapid clinical improvement before a definitive diagnosis is established. This case highlights the importance of a thorough history, particularly regarding animal exposures, including pet ownership. It also underscores the value of careful physical examination, even of seemingly benign findings such as healed scratch wounds. The patient’s swift recovery emphasizes the importance of early recognition and prompt treatment to reduce morbidity or mortality associated with this rare but potentially serious disease.

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