



Case report

Rat-bite fever: Taking the bite out of a textbook case of *Streptobacillus moniliformis* blood stream infection



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ABSTRACT

Increasing popularity of rats as domestic pets and continued use of rodents in scientific laboratories has contributed to a notable increase in reported cases of rat-bite fever caused by *Streptobacillus moniliformis* in the United States. *S. moniliformis* is a gram-negative filamentous bacterium that is a commensal bacterium found in the nasopharyngeal tract of rats. This is a case of a young male developing rat-bite fever bacteremia without a known bite from a rat, but with incidental contact with oral secretions. The patient developed significant debilitating symptoms including migratory polymyalgias and demonstrated complete recovery after treatment with ceftriaxone.

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Introduction

Records indicate that approximately 200 cases of rat-bite fever (RBF) have been documented in the United States [1]. Increasing popularity of rats as domestic pets and continued use of rodents in scientific laboratories has contributed to an increased incidence of reported cases. Caused by *Streptobacillus moniliformis*, a commensal bacterium in the nasopharyngeal system of various rodents, rat-bite fever may be difficult to recognize given its relative rarity, challenging growth in culture media, and non-specific clinical features upon presentation.

Across the United States, 0.33 per one million persons visit an Emergency Department for rat-bite fever, with approximately 60 % of patients diagnosed requiring hospitalization for further management. Rat-bite fever is most commonly seen in children aged up to 19 years of age, but the majority of hospitalizations occur in patients greater than 60 years old [2]. While not all rat bite injuries result in rat-bite fever, approximately 10 % will go on to demonstrate an infection. If left untreated, rat-bite fever has a mortality rate of approximately 13 % [1].

S. moniliformis can be pathogenic to humans when transmitted through skin or into other bodily fluids. Classically linked to physical biting with transfer of bodily fluids, more recently cases of rat-bite fever have been documented in patients handling rodents without obvious bite wounds suggesting fomite transmission [2,3]. A gram-negative filamentous rod, *S. moniliformis* is extremely fastidious requiring trypticase soy agar or broth enriched with 20 %

blood, serum or ascitic fluid to grow [1]. Due to its extremely slow growth, identification typically takes two or three days with some requiring up to seven days.

With initial presentation occurring between three and ten days after exposure, systemic illness is commonly characterized by non-specific findings of fever, rigors, headache and myalgias. Later presentation may often manifest as migratory polyarthralgias with or without systemic rash. Rat-bite fever has been implicated in several serious complications including endocarditis, myocarditis, pericarditis, pneumonitis, and focal abscesses with endocarditis being the most common and most deadly [1]. Rat-bite fever is often misdiagnosed, as demonstrated by this case of rat-bite fever requiring multiple visits to medical facilities with worsening symptoms each day after exposure.

Case

A 35-year-old male with no significant past medical history presented to the Emergency Department with complaints of nausea, vomiting, fever, chills, and black stools for two days. Patient reported possible exposure to a food-borne illness correlating to eating in a restaurant prior to onset of symptoms. Laboratory values were unremarkable, and patient was discharged without any prescription medications, with instructions to continue supportive cares for management of food-borne illness. The following day, the patient returned to the Emergency Department with pedal edema, fever, and rash on hands and feet. Patient was again discharged to home with recommended follow-up with Dermatology for further workup of fever of unknown origin and rash. Patient returned to the Emergency Department again the following day with further progression of petechial rash

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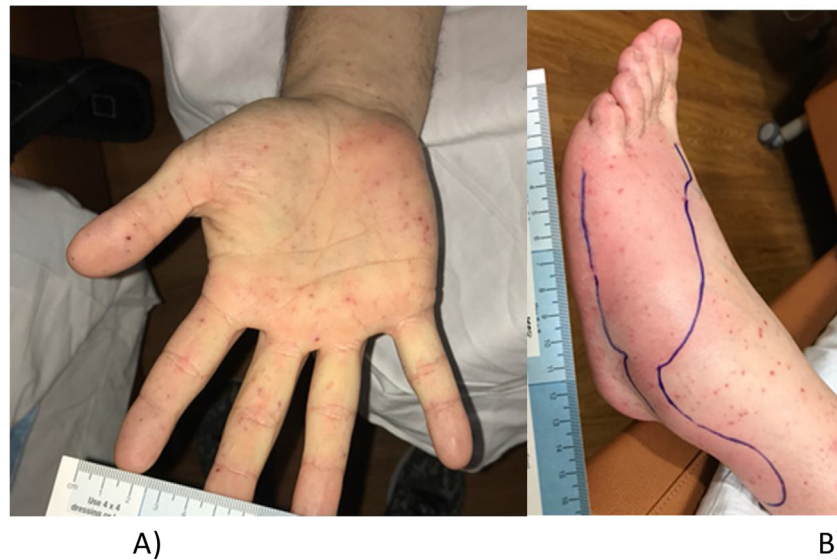


Fig. 1. A) right palm of hand demonstrating petechial rash B) Left foot with synovitis.

involving the palms of the hands and soles of the feet, see Fig. 1 (A), and new onset bilateral subconjunctival hemorrhages. Patient had developed generalized body aches especially in the joints and required a cane for assistance with ambulating. During this visit, it was noted that the patient had two blood cultures from a previous visit with growth after two days, identified only as gram negative bacteria, without identification of shape on the laboratory report. Patient was admitted to the hospital for further diagnostic workup of gram-negative bacteremia, rash, and joint myalgias.

Upon admission, white blood cell count was found to be within normal limits at 9.1×10^9 per liter. C-reactive protein was significantly elevated at 344.3 mg/L. A magnetic resonance image was completed of the left ankle, which showed severe synovitis with synovial enhancement of the peroneus longus and brevis, see Fig. 1 (B) and significant edema. All other laboratory values were within normal limits or unremarkable. By day two of admission, the bacteria had yet to be identified by the rapid diagnostic system employed at the facility. The Infectious Disease (ID) physician inspected the culture plate and noted appearance of a gram-negative bacillus with elongation and fusiform morphology. Given the symptoms, presentation, and appearance on culture plate, the preliminary diagnosis of rat-bite fever was made.

Detailed patient interview by ID physician, confirmed patient had many animals residing in the home. This included cats, dogs, bearded dragons, snakes, cockroaches, and several rats. Patient denied any recent animal bites but did report interacting with rats on a regular basis and was recently exposed to the oral flora while discarding a rat tooth. It is hypothesized that the exposure to the oral flora was the mechanism of transmission of disease from the rat to the patient.

The patient was empirically treated with ceftriaxone 2 g intravenously every twenty-four hours while cultures were pending further identification and had significant improvement in symptoms throughout hospitalization. Patient was able to discharge within three days of admission and completed treatment with outpatient infusions of ceftriaxone for a full 14-day course. The bacteria identified was *S. moniliformis* on day 7 and susceptibilities were not performed. At the completion of therapy, patient had normalization of C-reactive protein level and resolution of all symptoms including the polyarthralgias.

Discussion

Due to the rare incidence in the United States and non-specific presentation initially, rat-bite fever can be a difficult diagnosis to make. A complete patient history is an integral part of the patient workup to accurately determine the diagnosis. Symptom onset can occur anytime between three days and three weeks after initial exposure, but most patients experience symptoms within seven days of exposure [1]. Historically, rat-bite fever was a considered diagnosis only with known bite wound [1]. More recently, reports indicate other modes of transmission including incidental exposure to oral secretions or mucosa.

Patients may develop non-specific symptoms, including fevers, rigors, headache, nausea, vomiting, sore throat or myalgias during the initial stages of the disease. As the disease progresses, migratory polyarthralgias of both large and small joints appear to be a defining feature along with appearance of rash. The rash may be macropapular, petechial or purpuric in appearance. Typically presenting on the hands and feet, hemorrhagic vesicles may also develop as a sign of the disease. This constellation of symptoms should strongly suggest rat-bite fever as the appropriate diagnosis.

S. moniliformis demonstrates a broad sensitivity to a variety of antibiotics including penicillins, cephalosporins, clindamycin, vancomycin and tetracyclines. Penicillins and cephalosporins are considered the mainstay therapies in the treatment of rat-bite fever and are appropriate for empiric therapy while awaiting culture results to be confirmed. Given the tendency towards resistance or impaired susceptibility with *S. moniliformis*, aminoglycosides, fluoroquinolones and sulfamethoxazole/trimethoprim should be avoided as empiric therapy and only considered if isolate demonstrates susceptibility. Either oral or parenteral antibiotic formulations can be considered depending on the severity of illness, underlying source of infection and patient characteristics. Standard duration of treatment is 14 days with longer courses required for more complicated manifestations including pericarditis or endocarditis [1].

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Author contribution

Courtney Matthews: study design, literature review, writing
Sara Ausman: study design, literature review, writing

Declaration of Competing Interest

The authors report no declarations of interest.

References

- [1] Elliott SP. Rat bite fever and *Streptobacillus moniliformis*. Clin Microbiol Rev 2007;20(1):13–22.
- [2] Kache PA, et al. Rat-bite fever in the United States: an analysis using multiple national data sources, 2001–2015. Open Forum Infect Dis 2020;7(6).
- [3] Edwards R, Finch RG. Characterization and antibiotic susceptibilities of *Streptobacillus moniliformis*. J Med Microbiol 1986;(21):39–42.