

Answer: Rat Bite

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A 74-year-old Caucasian male with severe Alzheimer's disease (AD) presented to the emergency department with fever, lethargy, and a rash. Four days prior to presentation, he sustained an animal bite on his right hand while alone in his home garden. His wife cleaned the wound with soap and water, but no further medical attention was sought. The patient was unable to describe the animal that had bitten him or the circumstances around the event.

Over subsequent days, he developed swelling and erythema of the right hand that extended up to the elbow, with fever, rigors, shortness of breath, and progressive difficulty ambulating.

Physical examination. On presentation, the patient appeared comfortable but was febrile to 101.8°F. His conjunctiva were clear, with anicteric sclera and a clear oropharynx. He had no cranial nerve deficits and was able to follow simple commands and move all extremities.

His neck was supple, not tender, and he did not have cervical, axillary, or inguinal lymphadenopathy. Respiratory, cardiac, and abdominal examinations were normal.

A dry punctate wound on the right hand between the 2nd and 3rd metacarpals was evident, without surrounding erythema or discharge, and there was a diffuse macular rash on his bilateral upper and lower extremities with involvement of the palms (**Figure**).

He had no joint effusions or limitations in range of motion.

Laboratory tests. Laboratory testing revealed a neutrophil predominant

leukocytosis with a white blood cell count of 18,900/ μ L, 87% neutrophils (normal: 4000/ μ L–11,000/ μ L, 45% to 75% neutrophils), a mildly elevated aspartate transaminase of 38 U/L (normal 7 U/L–37 U/L), and an elevated total bilirubin of 2.4 mg/dL (normal: 0.3–1.2 mg/dL). His urine analysis and creatinine levels were normal. A chest x-ray showed no acute cardiopulmonary abnormalities.

The emergency department physician admitted the patient, obtained blood cultures, and started intravenous piperacillin-tazobactam.

Diagnosis. The inability of the patient to identify the biting animal allowed for a wide array of possible infections. The predominant pathogens in bite wounds include the normal oral flora of the biting animal in addition to human skin flora.¹

Follow-up testing. Following admission, the patient became progressively less cooperative, attempted to bite a nurse, and became somnolent with whole-body rigidity. An infectious diseases physician and the department of public health were contacted regarding suspected rabies infection, which was ultimately ruled out. The patient was eligible for rabies immunoglobulin and vaccine.

The combination of a fever with a macular rash following a bite from an unknown animal raised the concern for rat bite fever (RBF).

An EEG showed mild-to-moderate encephalopathy and no seizure activity. Admission blood cultures were negative, and additional samples were sent for further testing. On hospital day 10, the DNA testing confirmed a sequence match to *Streptobacillus*

moniliformis. A closer epidemiological investigation corroborated a possible rat bite occurrence; the patient's wife had observed recent rat activity in the yard where her husband was gardening.

Outcome of the case. The patient finished a 2-week course of antibiotics with amoxicillin, and was discharged to a rehabilitation facility.

RAT BITE FEVER

S. moniliformis, the primary causative agent of RBF in the United States, is a rare zoonotic disease.²⁻⁹ Nationally, over 200 cases have been documented; however, since RBF is not a nationally notifiable disease, this number is likely a great underestimate of the true case count.^{2,4-6,9}

Transmission of *S. moniliformis* occurs by direct contact through a bite or scratch from an infected rat or from exposure to their oral secretions or food/water contaminated with rat waste products. Less commonly, the disease can be transmitted by other rodents (eg, mice, gerbils, or squirrels) or rodent-eating animals (eg, weasels, cats, and dogs).

Symptoms. Symptom onset usually occurs within 3 to 10 days of exposure, but can take up to 3 weeks.²⁻⁹ They include the sudden onset of chills, fever, headache, muscle pain, and vomiting. Typically, within a few days after fever onset, a maculopapular rash develops over the extremities.

Treatment. Penicillin is most commonly used to treat *S. moniliformis* infections, but the bacterium is also sensitive to cephalosporins, macrolides, and tetracycline.²⁻⁹ If left untreated, severe sequelae, including endocarditis, myocarditis, meningitis, pneumonitis, septicemia, and hepatosplenomegaly can occur.²⁻⁹ The case fatality rate for RBF ranges from 7% to 13%.²⁻⁹

Discussion. Of the >2 million animal bites that are reported annually in the US, only 1% are attributed to rat bites.^{2,6,9} Until recently, persons most at-risk primarily included young children (<5 years of age), and particularly those living in poverty. Today, however, keeping rats as personal pets or using them for laboratory purposes has broadened those persons at-risk to include rat owners, pet shop employees, and laboratory workers.

It is estimated that 10% to 100% of domestic rats and 50% to 100% of wild rats are colonized with *S. moniliformis*.^{2-4,6,9} As such, occupational and recreational exposures to wild rats in particular are becoming a relevant risk factor for RBF—placing those persons who engage in outdoor activities like farming, hunting, and trapping at increased risk for disease.⁶

In the wake of severe weather activity, the likelihood of rodent-human interactions could be expected to rise. As such, what are considered rare zoonotic diseases may become more prevalent in the general population. Increased precipitation in warm months can lead to an amplified rat population size, as a result of increased vegetation and food availability.

On the other hand, increased rainfall can lead to flooding which, in turn, can upset the natural habitat for rodent populations. Interestingly, while such events may diminish the size of rat populations those that survive may seek to re-establish themselves around or inside homes, where they can come into contact with humans.¹⁰ At present, it is estimated that 10% of all rat bites result in *S. moniliformis* infection.^{2,3,6-9} An environmental site visit to the patient's residence did not yield any noticeable rodent activity around the outside property, which was well overgrown with vegetation.

Illnesses subsequent to known animal, mosquito, or tick bites may be easily diagnosed when the source of the bite is known and medical attention is promptly sought. When an unknown bite exposure occurs, prompt medical attention, combined with timely epidemiologic investigation is key to identification of disease and proper treatment. In such instances, medical providers should immediately report any bites of unknown origin to their local department of health for epidemiologic exposure and risk assessment.

Although rare, RBF should not be overlooked as a cause of disease when symptomology is compatible and the possibility of rat exposures exist. Ultimately, collaboration among the infectious disease physicians who treated the patient, the local and state health department epidemiologists who investigated disease exposures, and the state public health laboratorians who identified *S. moniliformis* in the patient specimen is what solved this mystery. ■

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Figure. Diffuse macular rash on the patient's lower extremity.