Wilderness and Environmental Medicine, **20,** 290–296 (2009)

CASE REPORT

Rabies Exposure—Implications for Wilderness Travelers

Evan T. Miller, MD; Regan H. Marsh, MD; N. Stuart Harris, MD, MFA, FACEP

From the Indiana University School of Medicine, Indianapolis, IN (Dr Miller); the Harvard Affiliated Emergency Medicine Residency, Brigham and Woman's and Massachusetts General Hospital, Boston, MA (Dr Marsh); and the Department of Emergency Medicine, Massachusetts General Hospital and Harvard School of Medicine, Boston, MA (Dr Harris).

Rabies is a preventable, fatal infectious disease. Successful vaccination programs for domestic animals in developed countries have drastically decreased the risk of exposure to rabies. Yet awareness of rabies needs to remain high as important reservoirs still exist in our backyards, the wilderness, and abroad. Recognizing the risk before and after a potential exposure, so that appropriate medical care can be sought, is critical to preventing a fatal complication. This case report involves an exposure of a medical student to an ill-appearing and likely rabid gray fox in the Gila Wilderness Area of New Mexico. The student was a member of a 28-day wilderness medicine course taught by the National Outdoor Leadership School/Wilderness Medicine Institute in collaboration with the Harvard Affiliated Emergency Medicine Residency. On the first night in the field, the student awoke to a gray fox biting his foot through his sleeping bag in the early morning hours. Subsequently the student was evacuated for medical evaluation. Further care consisted of rabies postexposure prophylaxis, including thorough wound cleansing, injection of human rabies immunoglobulin, and initiation of a rabies vaccination schedule. Immediate wound care with soap and water and a viricidal agent is of utmost importance for any animal bite, but especially so in the prevention of rabies. Indications for rabies prophylaxis are complex and require prompt evaluation by a medical professional and consultation with local epidemiology to guide treatment.

Key words: rabies, Gray fox, wild animals, animal bite, wilderness medicine

Introduction

Rabies presents as an acute progressive encephalitis that is fatal. Whereas clinical rabies is an infrequently encountered disease in the developed world, substantial reservoirs of the disease are present in the United States. Although rabies in domestic animals has been drastically decreased, numerous wild animal vectors exist and present an exposure risk in the wilderness setting.

Case report

The Wilderness Medicine Institute of National Outdoor Leadership School (NOLS) in partnership with the Harvard Affiliated Emergency Medicine Residency and the Massachusetts General Hospital Director of Wilderness Medicine leads a 28-day course, ''Medicine in the Wild,'' for third- and fourth-year medical students. ''Medicine in the Wild'' consists of a 48-hour, classroom-based clinical section (Wilderness Upgrade for Medical Professionals), followed by a 20-day field portion in the Gila Wilderness Area, New Mexico.

On the first night of the field section, a healthy 25-year-old student sleeping outside of a kiva shelter was awakened at 0430 hours by foot pain to find a fox biting through his sleeping bag. Despite immediate yelling and movement, the fox only released its bite and ran off after the student was able to slide an arm out of his mummy bag, strike the fox with a trekking pole twice, and then stand up still in his sleeping bag.

After waking other students and instructors, it was discovered that earlier in the evening students in another tent group (located approximately 500 m away) had been awakened by a fox walking on their sleeping bags inside their kiva shelter. In addition, the fox had dragged away

Corresponding author: Evan T. Miller, MD, Indiana University School of Medicine, Indianapolis, IN 46202 (e-mail: evtmille@gmail.com).

boots and other items before it was scared away. No bites or direct contact with the fox were noted to have occurred at this time.

On examination of the bitten student, a 1 cm superficial transdermal skin avulsion located on the medial aspect of the fourth digit of the right foot was documented. In addition, an obvious tear and puncture holes were present at the foot of the sleeping bag. No other bites were apparent. The wound was immediately irrigated with 2 L of water previously treated with chlorine dioxide, and the wound was disinfected with direct application of 2% aqueous chlorine dioxide by an additional course participant, a Harvard Affiliated Emergency Medicine Residency senior resident physician.

After the attack, the fox was intermittently spotted lurking in the dark outside of camp. The course instructors brought all the students to a central area, and a fire was started. The fox repeatedly tried to re-enter the camp area. In an attempt to drive off the oddly-behaving fox on one incursion, an instructor was successful in striking it with 2 stones. Subsequent attempts to locate the fox were unsuccessful. Once daylight arrived, NOLS's Southwest Branch emergency coordinator was contacted via satellite phone to discuss the incident. An evacuation and transportation plan was devised, and oral cephalexin was initiated. An evacuation team consisting of the (fully ambulatory) bitten student, an instructor, a resident physician, and an additional student departed at 0900 hours on a 3-mile evacuation hike to the trailhead. From the trailhead the patient was transported by a previously positioned NOLS vehicle and arrived at a regional medical center at approximately 1300 hours that same day.

At the medical facility, additional wound cleansing was done with povidone-iodine solution while the local treating emergency physician sought consultation with the New Mexico State Department of Health epidemiologist. After consultation, the emergency physician initiated rabies postexposure prophylaxis (PEP). The bite site was infiltrated with 2 mL of human rabies immunoglobulin (HRIG), and an additional 10 mL of HRIG was injected intramuscularly into bilateral gluteal muscles. Rabies vaccination was initiated in New Mexico and completed in the student's home state using 1.0 mL human diploid cell-purified vaccine (HDCV) administered intramuscularly in the deltoid region using the Essen Protocol of vaccine on days 0, 3, 7, 14, and 28.

A tetanus booster was given at the initial emergency room visit, and cephalexin was discontinued.

Early investigations were made by the evacuation team as to the feasibility of acquiring necessary doses of rabies vaccine (to be released to the accompanying licensed physician), which might enable the student to complete his vaccination schedule in the field. Although potentially technically feasible, given the potentially fatal downside of inadequate PEP, the decision was made by NOLS that the student should not return to the field. The remainder of the evacuation team then returned to the field and completed the full 20-day field section without incident. The student returned home and completed the PEP for rabies following the recommended schedule by the Advisory Committee on Immunization Practices (ACIP).[1]

Discussion

Awareness of rabies needs to remain high as important reservoirs still exist in populated domestic regions, the wilderness, and abroad. After an exposure, if PEP is not initiated empirically and effectively and clinical rabies develops, it is fatal. Although rare cases of survival of clinical rabies have been reported using various treatment protocols, none has proven effective.[2] Only 2 cases with mild to no neurologic sequelae have been documented, most notability a case involving the Milwaukee Protocol; however it has been unsuccessful in subsequent cases.[3–7] Prevention remains the only reasonable option. Worldwide, exposure to rabies from wild and domestic animals results in an estimated 55 000 deaths per year, which occur almost entirely in the developing world.[8]

In the United States and most developed countries, implementation of rabies control programs (most notably extensive vaccination programs of domestic animals in the 1940s) dramatically decreased the incidence of rabies in domestic animals by the 1960s.[9] Since that time the prevalence of rabies in wild animal reservoirs has become more apparent and now represents the dominant exposure risk in the developed world. Wild animals accounted for 93% of rabid animals in the United States during 2007 based on Center for Disease Control and Prevention (CDC) surveillance.[10] Despite advances in the eradication of domestic reservoirs, 1 to 2 deaths per year from rabies occur and an average of 16 000 to 39 000 people undergo PEP annually in the United States.[11]

Rabies prophylaxis is very effective, with no failures documented for correctly completed vaccination series in the United States since cell-purified vaccines have been utilized.[12] Proper recognition of exposure risk is pivotal in the prevention of rabies in humans, so that pre-exposure prophylaxis and PEP can be instituted. Of note, in one study in the United States it has been reported that in as many as 40% of cases in which PEP was given, it was not necessary. Perhaps of more concern, this study reported that an even higher rate existed where PEP was indicated and was not given.[13] Physician education of the