Assessing and Managing Mammal Bites

Animal bites can carry a serious risk of broken bones, neurovascular damage, infection, and psychological harm. Here's how to size up the situation.

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Humans interact with other mammals every day: pets, farm livestock, service animals, zoo and laboratory animals, and wild animals, both indigenous and nonindigenous. Add to that the growing prevalence of nontraditional companion animals (NCAs), such as prairie dogs, monkeys, and lemurs, and the lifetime risk of being bitten by a mammal rises to 50%.

This article explores pertinent aspects of managing mammal bites in the urgent care setting, including wound care, infection prophylaxis, and follow-up.

CASE #1: DOG BITE

A 5-year-old boy is bitten by a large neighborhood dog. The child's parents, who witnessed the event, report that the dog held the boy's arm and shook it violently. The dog is known to have an up-to-date vaccination profile. The child is tearful and appears to be in pain. On examination, you note that the forearm is bruised but the skin is intact, and there is reduced mobility in

the shoulder. The rest of the exam is normal. The child has no medical problems and his immunizations are up to date. Does this child need any further evaluation? What referrals should you provide?

CASE #2: MONKEY BITE

A 23-year-old woman reports that her pet green monkey bit her on the chest earlier today. The patient recently had a tetanus immunization. On exam, you note a bruised area on the chest with an associated superficial abrasion. Is any treatment indicated?

CASE #3: CAT BITE

A 45-year-old man presents with a bite wound on the forearm from his own cat. The cat is appropriately vaccinated. The wound is a small puncture without active bleeding. The arm is neurovascularly intact. The man requests a tetanus shot. Is any further evaluation or treatment indicated?

COMMON BUT OFTEN UNREPORTED

About 1% of emergency department and urgent care visits each year are for mammal bite injuries or their complications. Ten to 20 people die each year from mammal bites. In 2006, 310,710 injuries from dog bites alone were reported to the Centers for Disease Control and Prevention. The actual number of bite wounds from all mammals is estimated to be around 2 million each year, but that figure underestimates the true incidence because most animal bites are unreported.

Animal bite injuries include lacerations, punctures, crush injuries, tears, rips, avulsions, fractures, hemorrhage, and contusions. The type and severity of injury depend on the location of the bite, the species of animal, and size of the patient. For instance, animals with large, strong jaws, especially large dogs, inflict crush, avulsion, and tearing wounds. Dog bite injuries are divided about equally among lacerations, puncture wounds, and superficial abrasions. Feline and large rodent bites are more often deep puncture wounds as opposed to lacerations or tears.

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The most common bite injuries are from dogs, followed by cats. Bite wounds from mammals that are not household pets or from NCA mammals make up a minority of reported bites. However, they will be discussed in this article because, without proper care, these bites can cause significant morbidity and mortality.

More than two-thirds of bite injuries occur in children younger than 10 years old—boys more often than girls. Children most commonly present with bite wounds to the face, neck, and head. Adults more commonly present with bites to the extremities.

HISTORY AND PHYSICAL EXAM TIPS

Patients usually seek medical care after bites for repair of the wound or because the wound has become infected. A thorough history of the event includes asking about the timing of the injury, the kind of animal involved, its health history (including vaccination status and current health), and its behavior. Other important information about the animal includes whether it can be observed or captured.

Thoroughly examine patients with bites. Bear in mind that the most painful or obvious injury may distract the patient from additional injuries, so check areas adjacent to the bite as well. In particular, if the patient is a young child or has been mauled by an animal, check the entire body to identify additional injuries.

Examine the wound itself meticulously. Many aspects of mammal bites are not apparent on cursory evaluation. Tears, punctures, and crush wounds can have extensive subcutaneous involvement. Flaps and avulsions may hide wound contaminants and foreign bodies, such as teeth.

Be alert for injuries to the vasculature, nerves, tendons, bones, and joints. Examine tendons along their full range of motion. A neurovascular assessment of pulses, motor function, and sensation distal to wounds should precede and follow all exploration and management. Neurovascular structures and tendons can be exposed and injured in avulsions, large lacerations, punctures, and crush injuries.

Bites from large mammals can damage and even fracture bone. Large dogs can produce bite pressures in excess of 450 psi. The direct force of a bite can fracture delicate bones of the hand,

foot, and face. The crushing aspect of a large animal bite can fracture long bones. A detailed physical examination is needed to discover subtle fractures. Plain radiographs should be viewed after the exam.

Large mammals who bite and shake can dislocate joints. Have patients perform active range-of-motion with joints that are near bite wounds. Evaluate the joint for disruption of the capsule (open joint). Joint injection with methylene blue is the most effective nonoperative assessment technique for subtle capsule disruption. Maintain a low threshold for injecting joints. Missed open joints can lead to significant morbidity.

Use plain radiography to assess for retained foreign bodies and skeletal injuries. Computed tomography and magnetic resonance imaging have increased sensitivity for foreign bodies and subtle fractures. In cases of high suspicion and negative plain films, use these imaging techniques. Identifying foreign bodies requires careful examination with ample light in a bloodless field. Plain films of the affected area complement, but do not replace, exploration for foreign bodies.

REDUCING THE RISK OF INFECTION

Standard principles of wound care apply to mammal bites. (Routine cultures are not indicated and are poor predictors of infection.) Copiously irrigate all bites; irrigation reduces the incidence of viral and bacterial infections. Debride the wound generously: Devitalized tissue does not function as a "biological dressing." It acts as a nidus for infection and should not be retained.

Bites are tetanus-prone wounds. Patients who have not had tetanus immunization within the last five years should receive appropriate tetanus prophylaxis. For patients without the primary series of tetanus immunizations, refer to the CDC guidelines.

The practice pattern is to close the majority of wounds primarily. When deciding to close the wound, assess its location and size, degree of contamination, functional impairment, cosmetic outcome, and time from injury. Uncomplicated wounds greater than 1.5 cm in cosmetically sensitive areas can be primarily closed with minimal risk of infection. It's expected that a small percentage of wounds will become infected and require early suture removal. Inform patients that wound infections may occur in spite of the appropriate care. Advise all patients at discharge to look for signs of infection, such as redness, increasing pain, and purulent drainage.

Animal Bites With a High Risk for Infection

- crush injuries
- hand wounds
- puncture wounds
- wounds with extensive devitalized tissue
- heavily contaminated wounds
- prolonged time from injury to treatment:
  6–12 hours on the body
  12–24 hours on the face

Some bite wounds have a higher risk of infection (see box). Puncture wounds, for instance, whether closed or left open, become infected more often than other wounds. (Wounds that extend more deeply than their length are considered puncture wounds, regardless of the size of the entry wound.) Crush wounds, even when debrided properly, also have an increased risk of infection.

Location plays a significant role in determining the management of bite wounds. The overall infection rate of head and neck wounds that are primarily closed is low (1.4% to 6%). Despite the risk of infection, primary closure may be necessary because most wounds to the face are in cosmetically sensitive areas. Bite wounds to the hands have a higher potential for infection and significant morbidity as a result of infection. Although hand wounds are still commonly closed, consider leaving high-risk wounds open.

>>FAST TRACK<<

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Older wounds are also at higher risk for infection. As a guideline, a wound 6 to 12 hours from the time of injury is considered old on the body. Face wounds 12 to 24 hours after the incident are

Infectious Bacteria from Animal Bites

Animal	Bacteria
dog	*Staphylococcus aureus* *Staphylococcus epidermidis* α-hemolytic streptococci β-hemolytic streptococci *Pasteurella multocida* *Pasteurella canis* *Prevotella* *Bacteroides* *Fusobacterium* *Porphyromonas* *Leptospira interrogans* Rhabdoviridae (rabies) *Capnocytophaga canimorsus* *Capnocytophaga cynodegmi*
cat	*Staphylococcus aureus* *Staphylococcus epidermidis* α-hemolytic streptococci β-hemolytic streptococci *Pasteurella multocida* *Pasteurella septica* *Prevotella* *Bacteroides* *Fusobacterium* *Porphyromonas* *Propionibacterium* *Francisella tularensis*
rat	*Streptobacillus moniliformis* *Escherichia coli* *Leptospira interrogans*
hamster	*Francisella tularensis*
ferret	*Staphylococcus aureus*
primates *(non-human)*	*Streptococcus* *Enterococcus* *Staphylococcus* *Eikenella corrodens* *Neisseria* Enterobacteriaceae Cercopithecinae herpesvirus 1 (B virus) (from macaques)

considered old. These times are arbitrary, not absolute, and should be considered as only one factor in deciding whether to close the wound.

Some practitioners apply the concept of "loose approximation" or suturing in a manner that leaves gaps when treating wounds at risk for infection, but this practice has not been subject to objective scientific evaluation.

TAILORING THE TREATMENT

Although principles of wound care can be generalized to all bite wounds, each mammalian species poses its own unique infectious risk. Infections of bite wounds come from both invasion of native skin flora and bacteria introduced by the mouth of the animal. The majority of wound infections from mammalian bites are polymicrobial (see table).

Pasteurella, common in dog and cat bites, is known for a rapid onset and spread. These infections are usually clinically apparent within 24 hours of the bite and progress rapidly. Staphyloccal and streptococcal infections are slower to appear.

Here are some specific considerations to keep in mind.

Dog bites. A big fear with dog bites is rabies, but while domestic dogs do carry rabies, the actual incidence among these dogs in the United States is low. Similarly, few dog bites actually lead to infection, largely because most dog bites are nips rather than a true bite. However, significant bites are at risk for infection, which is usually polymicrobial. About 50% of infected dog bites involve *Pasteurella canis*. The first-line antibiotic is amoxicillin/clavulanic acid 875 mg orally twice daily for adults and 10 to 15 mg/kg orally three times daily for children (see table on page 39). Duration of therapy is not clearly established.

Cat bites. In contrast to dog bites, most cat bites do become infected. *Pasteurella multocida* is present in 70% to 90% of the infections. Antibiotic post-exposure prophylaxis that is effective for *P. multocida* is recommended for all cat bites; unfortunately, *P. multocida* is resistant to clindamycin, dicloxicillin, cephalexin, and erythromycin. The first-line antibiotic is amoxicillin/clavulanic acid 875 mg orally

Infection Prophylaxis for Mammal Bites

	Dog bite	Cat bite	Macaque bite	Rat bite
First line				
adult	amoxicillin/clavulanic acid 875 mg PO b.i.d.	amoxicillin/clavulanic acid 875 mg PO b.i.d.	valacyclovir 1 gm PO t.i.d. for 14 days	amoxicillin/clavulanic acid 875 mg PO b.i.d.
child	amoxicillin/clavulanic acid 10–15 mg/kg PO t.i.d.	amoxicillin/clavulanic acid 10–15 mg/kg PO t.i.d.	no pediatric dose	amoxicillin/clavulanic acid 10–15 mg/kg PO t.i.d.
Alternative				
adult	clindamycin 300 mg PO t.i.d. + fluoroquinolone	cefuroxime 500 mg PO b.i.d. OR doxycycline 100 mg PO b.i.d.	acyclovir* 800 mg PO 5 times daily for 14 days	doxycycline 100 mg PO b.i.d.
child	clindamycin 8–25 mg/kg/day PO divided b.i.d. or t.i.d. + TMP-SMZ 5 ml suspension/10kg/day PO b.i.d. up to 20 ml	cefuroxime 50 mg/kg/day PO divided b.i.d.	acyclovir* 20 mg/kg PO 5 times daily	cefuroxime 50 mg/kg/day PO divided b.i.d.

*acyclovir and valacyclovir considered equivalent
TMP-SMZ = trimethoprim-sulfamethoxazole

twice daily in adults, 10 to 15 mg/kg orally three times daily for children. Duration of therapy is not clearly established.

Cats have the highest incidence of rabies of all domestic animals in the United States. However, transfer to humans remains rare.

Primate bites. A subgroup of primates called the macaques (rhesus and green monkeys) carry B virus (Cercopithecine herpesvirus 1), usually by the age of 2. Though asymptomatic in the macaques, B virus causes fatal encephalitis in humans; 24 of the 25 humans known to be infected have died. The incidence of transmission is unknown, but it has been documented to occur from even trivial wounds. Due to the high mortality, post-bite prophylaxis is recommended for any macaque bite. First-line therapy is valacyclovir 1 gram orally every 8 hours for 14 days.

Primate bite wounds do not have unique bacterial infectious concerns. Post-exposure bacterial prophylaxis is indicated based on the extent and location of the wound. This follows the principles of post-exposure antibiotics for general wound care.

Primates in the United States rarely carry rabies. Most cases of rabies in primates in this country are found in animals recently imported from areas where rabies is endemic.

Rodent and rabbit bites. Rodents, rabbits, and hares carry *Francisella tularemia* and can transmit this to humans through bites. The CDC does not recommend routine prophylaxis for tularemia from the bite of a rodent.

Domestic and wild rats in the United States carry and transmit *Streptobacillus moniliformis*, which causes rat bite fever. The CDC recommends post-bite prophylaxis after wild or domestic rat bites.The first-line antibiotic is amoxicillin/clavulanic acid 875 mg orally twice daily for

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adults and 10 to 15 mg/kg orally three times daily for children. Duration of therapy is not clearly established.

Despite the common distrust of rats, it's rare for small rodents to carry rabies.

PSYCHOLOGICAL SUPPORT

Practitioners often neglect the psychological aspect of animal bites. An accident in rough play with an animal may not create psychological sequelae but an aggressive attack or mauling can have a lasting impact. In fact, post-traumatic stress disorder (PTSD) after a dog bite is not uncommon. In one study, 23% of children who had been bitten by dogs met the full criteria for PTSD and 32% met partial criteria. However, psychological support was not provided for any of these patients.

As the wound itself heals, long-term nonphysical complications may still be a threat. Traumatic experiences in children, such as dog bites, can lead to aggressive behavior, impaired language development, and poor academic performance. Patients' primary care physicians should inquire about psychological sequelae during subsequent visits. Referral to a mental health professional is indicated for patients who report persistent effects from the event.

CASE CONCLUSIONS

Appropriate management of the three patients presented at the beginning at this article would be as follows:

Case #1: Dog bite. This child should be evaluated for an orthopedic injury inflicted by the powerful shaking action of the dog. In particular, look for bony injury to the forearm, dislocation of the shoulder, and soft tissue injury of the shoulder. Refer the patient to an orthopedist if an injury is identified. In addition, because a violent attack can have psychological sequelae, advise the parents to discuss this with their primary care physician at follow-up, in case referral to a mental health professional is needed.

Case #2: Monkey bite. This patient, whose monkey inflicted a small, superficial abrasion to her chest, needs prophylaxis for B virus with an anti-viral agent. Transmission of virus B occurs through even trivial wounds and ocular exposure to saliva. Copiously irrigate the wound, which will reduce the chance of infection from B virus.

Case #3: Cat bite. A plain radiograph to evaluate for a retained tooth would be appropriate for this patient. The wound should be copiously irrigated and antibiotic prophylaxis prescribed. □

SUGGESTED READING

Brook I: Microbiology and management of human and animal bite wound infections. *Prim Care* 30(1):25, 2003.

Cohen JI, et al.; B Virus Working Group: Recommendations for prevention of and therapy for exposure to B virus (cercopithecine herpesvirus 1). *Clin Infect Dis* 35(10):1191, 2002.

Gilbert DN, et al.: *Sanford Guide to Antimicrobial Therapy 2007*. 37th ed, Antimicrobial Therapy, Inc, 2007.

Goldstein EJ, et al.: Simian bites and bacterial infection. *Clin Infect Dis* 20(6):1551, 1995.

Johnson-Delaney CA: Safety issues in the exotic pet practice. *Vet Clin North Am Exot Anim Pract* 8(3):515, 2005.

Medeiros I and Saconato H: Antibiotic prophylaxis for mammalian bites. *Cochrane Database Syst Rev*. (2): CD001738, 2001.

Nakamura Y and Daya M: Use of appropriate antimicrobials in wound management. *Emerg Med Clin North Am* 25(1):159, 2007.

Peters V, et al.: Posttraumatic stress disorder after dog bites in children. *J Pediatr* 144(1):121, 2004.

Talan DA, et al.: Bacteriologic analysis of infected dog and cat bites. *N Engl J Med* 340(2):85, 1999.

Turner TW: Do mammalian bites require antibiotic prophylaxis? *Ann Emerg Med* 44(3):274, 2004.

Weiss HB, et al.: Incidence of dog bite injuries treated in emergency departments. *JAMA* 279(1):51, 1998.