

Prevention and Treatment of Dog Bites

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Almost one half of all dog bites involve an animal owned by the victim's family or neighbors. A large percentage of dog bite victims are children. Although some breeds of dogs have been identified as being more aggressive than other breeds, any dog may attack when threatened. All dog bites carry a risk of infection, but immediate copious irrigation can significantly decrease that risk. Assessment for the risk of tetanus and rabies virus infection, and subsequent selection of prophylactic antibiotics, are essential in the management of dog bites. The dog bite injury should be documented with photographs and diagrams when appropriate. Family physicians should educate parents and children on ways to prevent dog bites. (*Am Fam Physician* 2001; 63:1567-72,1573-4.)

O A patient information handout on the prevention and treatment of dog bites, written by the author of this article, is provided on page 1573.

Each year approximately 4 million Americans are bitten by dogs, and about 800,000 of these persons (44 percent of whom are younger than 14 years) present for medical treatment.¹⁻³ More than one dozen fatalities related to dog bites occur each year in this country; most of these victims are children.^{1,2} Although most dog bite attacks are not provoked,³ there are several measures that adults and children can take to decrease the possibility of being bitten. Family physicians can educate parents and children on ways to prevent dog bites, but, when dog bites do occur, the physician must be knowledgeable about how to treat the bites effectively.

As of 1994, an estimated 34 million American households owned at least one dog, accounting for a canine population in the United States in excess of 55 million.^{1,2,4} Most dogs never bite a human; however, under certain circumstances, any dog is capable of inflicting harm. The most common victims of dog bites are children, especially in incidents that prove fatal.^{2,5-7} Almost one half of all reported cases of dog bites involve an animal owned by the victim's family or the victim's neighbors.³ Most victims are involved in normal, nonprovoking activities before the dog attacks.² For example, neonatal deaths result-

ing from a dog bite most often involve a sleeping baby.^{1,2}

Several dog breeds have been identified for their role in fatal dog bite attacks, including pit bull breeds, malamutes, chows, Rottweilers, huskies, German shepherds and wolf hybrids.^{1,2,8} From 1979 to 1988, pit bull breeds accounted for more than 41 percent of dog bite-related fatalities, three times as many as German shepherds.²

Management of Dog Bites

INITIAL WOUND MANAGEMENT

After confirming that the victim is medically stable, physicians should begin a primary assessment by taking a history. Several medical conditions place a patient at high risk of wound and rabies virus infection from a dog bite (*Table 1*).⁷ Information that can help determine the patient's risk of infection

TABLE 1
Medical Conditions Associated with a High Risk of Infection After a Dog Bite

Chronic disease	Previous mastectomy
Chronic edema of the extremity	Prosthetic valve or joint
Diabetes mellitus	Splenectomy
Immunosuppression	Systemic lupus erythematosus
Liver dysfunction	

Adapted with permission from Lewis KT, Stiles M. Management of cat and dog bites. *Am Fam Physician* 1995;52:482.

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Treatment with prophylactic antibiotics for three to seven days is appropriate for dog bite wounds, unless the risk of infection is low or the wound is superficial.

includes the time of the injury, whether the animal was provoked, and the general health, immunization status and current location of the animal.⁷ In some locations, notification of animal control or local law enforcement may be necessary. Also, the patient's tetanus immunization status, current medications and allergies must be noted in the record.⁷ During the physical examination, the measurement and classification of the wound (laceration, puncture, crushing or avulsion), and the range of motion of the affected and adjacent areas should be documented. Nerve, vascular and motor function, including pertinent negative findings, should be recorded. Diagrams and photographs are useful, especially in cases with irregular wounds or signs of infection,⁹ and in cases that may involve litigation, such as a wound inflicted by an unleashed dog.⁷

Timely and copious irrigation with normal saline or Ringer's lactate solution may reduce the rate of infection markedly. Injection of the tissue with irrigant solution should be avoided, because this can spread the infection.^{5,7} Necrotic or devitalized tissues should be removed, but care must be taken not to debride so much tissue as to cause problems with wound closure and appearance.⁹ Baseline

radiographs may be obtained, especially with puncture wounds near a joint or bone.⁵

The role of wound closure remains controversial. Puncture wounds, wounds that appear clinically infected and wounds more than 24 hours old may have a better outcome with delayed primary closure or healing by secondary intention.^{5,6} Some physicians close wounds that are less than eight hours old and wounds located on the face.⁵ The success of closing facial wounds can probably be attributed to the enhanced blood supply to the face and the lack of dependent edema.⁵ Plastic surgery, general surgery or maxillofacial surgery may be necessary for deep wounds or those requiring significant debridement and closure. Cultures are usually not helpful unless the wound appears infected or is unresponsive to appropriate antibiotic therapy. When a culture is necessary, aerobic and anaerobic cultures should be obtained and observed for a minimum of seven to 10 days to allow for slow-growing pathogens.⁷ Orthopedic consultation should be considered for wounds that directly involve joints or other bony structures.

ANTIBIOTIC TREATMENT

Only 15 to 20 percent of dog bite wounds become infected. Crush injuries, puncture wounds and hand wounds are more likely to become infected than scratches or tears.⁹ Most infected dog bite wounds yield polymicrobial organisms.⁸ *Pasteurella multocida* and *Staphylococcus aureus* are the most common aerobic organisms, occurring in 20 to 30 percent of infected dog bite wounds.^{4,5} Other possible aerobic pathogens include *Streptococcus* species, *Corynebacterium* species, *Eikenella corrodens* and *Capnocytophaga canimorsus* (formerly known as DF-2).^{5,7,8} Anaerobic organisms, including *Bacteroides fragilis*, *Fusobacterium* species and *Veillonella parvula*, have also been implicated in infected dog bites. One review article⁸ identified 28 species of aerobic organisms and 12 species of anaerobic organisms isolated from dog bite wounds.

Treatment with prophylactic antibiotics for

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three to seven days is appropriate for dog bite wounds, unless the risk of infection is low or the wound is superficial.^{4,5,7} If frank cellulitis is evident, a 10- to 14-day course of treatment is more appropriate.⁹ Amoxicillin-clavulanate potassium (Augmentin) is the antibiotic of choice for a dog bite. For patients who are allergic to penicillin, doxycycline (Vibramycin) is an acceptable alternative, except for children younger than eight years and pregnant women. Erythromycin can also be used, but the risk of treatment failure is greater because of antimicrobial resistance.^{7,10} Other acceptable combinations include clindamycin (Cleocin) and a fluoroquinolone in adults or clindamycin and trimethoprim-sulfamethoxazole (Bactrim, Septra) in children.¹¹ When compliance is a concern, daily intramuscular injections of ceftriaxone (Rocephin) are appropriate.⁷

Occasionally, outpatient treatment of infection fails and the patient needs to be hospitalized and treated intravenously with antibiotics. Reasons for hospitalization include systemic signs of infection; fever or chills; severe or rapidly spreading cellulitis or advancement of cellulitis past one joint; and involvement of a bone, joint, tendon or nerve.⁵

Consultation with a maxillofacial or plastic surgeon may be required if the patient has a facial or other highly visible wound. For patients hospitalized with cellulitis or abscess formation in an extremity, surgical consultation should be considered immediately because of the risk of worsening infection and tissue damage. Depending on community practices and the location of the injury, general orthopedic surgery, hand surgery or general surgery consultation may be appropriate. Tetanus immunization and tetanus immune globulin should be administered, if appropriate. Recommendations for tetanus prophylaxis are given in *Table 2*.¹²

ASSESSING THE RISK OF RABIES

The patient's risk of infection with rabies virus must be addressed immediately. Because of the serious risk to the public of a rabid ani-

mal on the loose, it is important to document the conditions surrounding the attack. As a result of widespread vaccination of dogs against rabies in the United States, the most common source of the rabies virus is now wild animals, specifically raccoons, skunks and bats.⁷ Nonetheless, there are still reported cases of rabies virus associated with a dog bite.¹³ Patients with a bite from a nonprovoked dog should be considered at higher risk for rabies infection than patients with a bite from a provoked dog. If the dog owner is reliable and can confirm that the animal's vaccination against rabies virus is current, the dog may be observed at the owner's home. Observation by a veterinarian is appropriate when

TABLE 2
Summary of ACIP Recommendations for Tetanus Prophylaxis in Routine Wound Management

	Clean, minor wounds		All other wounds*	
	Td†	TIG	Td†	TIG
History of adsorbed tetanus toxoid (doses)				
Unknown or less than three	Yes	No	Yes	Yes
Three or more‡	No§	No	No	No

ACIP = Advisory Committee on Immunization Practices; DTP = diphtheria tetanus and pertussis; Td = tetanus and diphtheria toxoids adsorbed (adult); TIG = tetanus immune globulin (Hyper-Tet).

*—Including, but not limited to, wounds contaminated with dirt, feces, soil or saliva; puncture wounds; avulsions; and wounds resulting from missiles, crushing, burns and frostbite.

†—For children younger than seven years, DTP (dT, if pertussis vaccine is contraindicated) is preferred to tetanus toxoid alone. For persons seven years or older, Td is preferred to tetanus toxoid alone. Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP) may be used instead of DTP for the fourth and fifth doses.

‡—If only three doses of fluid toxoid have been received, then a fourth dose of toxoid, preferably an adsorbed toxoid, should be given to complete the series.

§—Yes, if it has been more than 10 years since the last dose.

||—Yes, if it has been more than five years since the last dose. (More frequent boosters are not needed and can accentuate side effects.)

From Diphtheria, tetanus, and pertussis: recommendations for vaccine use and other preventive measures. Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 1991;40:21.

the vaccination status of the animal is unknown. If the animal cannot be quarantined for 10 days, the dog bite victim should receive rabies immunization.

Rabies immunization should begin within 48 hours after the bite, but it can be subsequently discontinued if the animal is shown to be free of rabies virus. Rabies immunization consists of an active immune response with a vaccine and a passive immune response with rabies immune globulin (RIG). Guidelines for rabies immunization are given in *Table 3*.¹⁴

Three types of rabies vaccine are currently available in the United States: human diploid cell vaccine (HDCV), rabies vaccine adsorbed (RVA) and purified chick embryo cell vaccine (PCEC). All are formulated for intramuscular

use, but HDCV is also available for intradermal use.¹⁴ All forms seem to have equivalent safety and efficacy.^{14,15} Once the vaccine series has begun, it is usually completed with the same vaccine type. Vaccine is administered on days 0, 3, 7, 14 and 28.

RIG is administered once and provides rapid immunity with a half-life of 21 days.¹⁴ RIG is not administered to patients who have been previously vaccinated.¹⁴

FOLLOW-UP

Patients who have been bitten by a dog should be instructed to elevate and immobilize the involved area. Most bite wounds should be reexamined in 24 to 48 hours, especially bites to the hands.⁹

TABLE 3
Guidelines for Rabies Immunization

Vaccination status	Treatment	Regimen*
Not previously vaccinated	RIG	Administer 20 IU per kg body weight. If anatomically feasible, the full dose should be infiltrated around the wound(s) and any remaining volume should be administered IM at an anatomic site distant from vaccine administration. Also, RIG should not be administered in the same syringe as vaccine. Because RIG may partially suppress active production of antibody, no more than the recommended dose should be given.
	Vaccine	HDCV, RVA, or PCEC 1 mL, IM (deltoid area†), once daily on days 0‡, 3, 7, 14 and 28
Previously vaccinated§	RIG	RIG should not be administered.
	Vaccine	HDCV, RVA, or PCEC 1.0 mL, IM (deltoid area†), once daily on days 0‡ and 3

RIG = rabies immune globulin; IU = immunizing unit; IM = intramuscularly; HDCV = human diploid cell vaccine; RVA = rabies vaccine adsorbed; PCEC = purified chick embryo cell vaccine.

*—These regimens apply to all age groups, including children.

†—The deltoid area is the only acceptable site of vaccination for adults and older children. For younger children, the outer aspect of the thigh may be used. Vaccine should never be administered in the gluteal area.

‡—Day 0 is the day the first dose of vaccine is administered.

§—Any person with a history of preexposure vaccination with HDCV, RVA or PCEC, prior postexposure prophylaxis with HDCV, RVA or PCEC, or previous vaccination with any other type of rabies vaccine and a documented history of antibody response to the prior vaccination.

Reprinted from *Human rabies prevention—United States, 1999. Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 1999;48(RR-1):1-21* [Published erratum appears in *MMWR Morb Mortal Wkly Rep 1999;48:16*].

TABLE 4
Breed-Specific Information
About Aggressiveness*

Aggressive dogs (higher attack rate)	
Bull Terrier	German Shepherd dog
Cocker Spaniel	Great Dane
Chow Chow	Pit bull
Collie	Rottweiler
Doberman Pinscher	Siberian Husky
Less aggressive dogs ("family dogs")	
Boxer	Golden Retriever
Dalmatian	Irish Setter
English Setter	Labrador Retriever
English Springer	Spaniel

*—In alphabetical order.

Information from Iazzetti L. Anticipatory guidance: having a dog in the family. *J Pediatr Health Care* 1998;12:73-9, and Bradshaw JW, Goodwin D, Lea AM, Whitehead SL. A survey of the behavioural characteristics of pure-bred dogs in the United Kingdom. *Vet Rec* 1996;

Prevention of Dog Bites

WHEN FAMILIES ARE CONSIDERING GETTING A DOG

Dogs can play an important role in family life. As the canine population grows, so does the need for guidance to prevent dog bites. Prevention can begin with information from primary care professionals and veterinarians. Because a large percentage of dog bite victims are younger than 14 years, it is appropriate to begin prevention education with children and parents. Families acquiring a pet should consider their home environment and be told that a dog younger than four months is preferred. An older dog should not be introduced into a household with children because the dog's behavior cannot be predicted. Prospective dog owners should obtain breed-specific information before getting a new dog.

Some breeds of dogs are more likely to attack despite training. Other breeds seem to

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be accepted more as "family dogs" (Table 4).^{4,16} Families should be educated to avoid "humanizing" their dog (e.g., allowing it to sleep on the furniture and to beg for food at the dinner table) and treating the dog as a child or a substitute for a mate.⁴ This type of behavior makes it more difficult for the animal to distinguish between animal and master and may increase the risk of the dog biting.

BEHAVIOR TO PREVENT A BITE

Measures for preventing dog bites are given in Table 5.² Dogs have a tendency to chase a moving object. Therefore, children need to learn to avoid running and screaming in the presence of a dog. Dogs should not be greeted by presenting an outstretched hand. Do not pet a dog without letting it sniff you first. Hugging and "kissing" a dog express a sense of submission to the animal, which is confusing because the animal is used to viewing humans as being in charge.⁴ This confusion may lead to more aggressive behavior by the animal.

TABLE 5
Measures for Preventing Dog Bites

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Educate children and adults to remain calm when threatened by a dog. Direct eye contact should be avoided because the dog may interpret that as aggression. Standing still (“like a tree”) with feet together, fists folded under the neck, and arms placed against the chest is recommended. If knocked to the ground by a dog, recommendations include lying face down and becoming still “like a log,” with legs together and fists behind the neck with forearms covering the ears. If a dog perceives no movement, it will lose interest and go away.

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