Bite Wounds in Dogs and Cats

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Dog bite wounds present like the tip of an iceberg. Because the dog’s canine teeth are not at a 90° angle, they do not go directly in and out when they penetrate the skin but rather pull the skin from the underlying tissue. Cats’ canine teeth are at a 90° angle, and thus cat bites have a more staccato penetration without as much underlying tissue damage. Cat bites tend to form abscesses and cellulitis, whereas dog bites can create extensive damage to underlying tissue because of shearing, tensile, or compressive forces. Tensile forces usually cause avulsion of the skin and deeper tissue layers, resulting in muscle damage and possibly herniation. Compressive forces can be as great as 450 psi, potentially causing fractures or serious tissue devitalization. Any full-thickness skin bite wound should be considered contaminated. Because of the potential for systemic disease, all bite wounds should be examined thoroughly (including surgical exploration of more extensive wounds, especially those that penetrate the abdomen) and treated appropriately.

Diagnostic Criteria

Historical Information
Gender Predisposition: Free-roaming intact males may be predisposed because of their wandering and fighting habits.

Age/Breed Predisposition: None.

Owner Observations
* History of dog or cat fights.

Physical Examination Findings
* Bloody wounds.
* Puncture sites.
* Signs of shock, including lethargy, depression, mentation changes, increased respiration rate, and cool extremities.

• Hypovolemic shock (capillary refill time >2 seconds, weak pulses, tachycardia, cool extremities, and poor mentation).
• Laceration or rupture of major vessels, which usually causes severe bleeding. Animals that have lost a large amount of blood may appear weak and anemic. In some cases, bleeding can be evidenced by swelling of a limb or the abdominal cavity.
• Punctures into the respiratory tract, larynx, trachea, or chest: Upper airway damage or partial obstructions can cause inspiratory dyspnea and stridor. Tracheal punctures can cause subcutaneous emphysema. Trauma to the chest can cause chest wall defects (e.g., flail chest). Pneumothorax may be present if the chest wall is not injured but the bronchi or lungs are lacerated. Patients with pneumothorax usually present with shallow and rapid respirations.

Inside this issue:

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7 Management of Arrow Wounds
Neurologic signs caused by puncture wounds to the central nervous system. Paresis, tetraparesis, paralysis, or tetraparalysis may be present depending on the location and extent of injury to the spinal cord. Mental status may be severely depressed, semicomatose, or comatose. Pupil size and pupillary light reflexes may vary.

Abdominal punctures can cause tears and herniation, including diaphragmatic hernia.

Orthopedic trauma may include fractures and joint penetration.

Most puncture wounds in dogs are to the neck, limbs, head, and trunk. Cats usually have wounds on their limbs or in the perineal region.

Puncture wounds can be difficult to locate in patients with dense, long haircoats.

### Laboratory Findings

- Laboratory findings tend to be unremarkable.
- Complete blood cell counts may show an inflammatory or stress leukogram. Anemia may be present but is not readily evident initially.
- The chemical profile is usually normal. Glucose may be elevated if serious head damage has occurred. Studies have indicated that the higher the blood glucose is after injury, the more serious the brain lesion.
- Positive (65%) and negative (35%) aerobic cultures. The most common organisms isolated from dog bite wounds are *Staphylococcus intermedius*, *Enterococcus*, coagulase-negative *Staphylococcus*, *Escherichia coli*, and *Pasteurella* spp. Anaerobic bacteria were isolated in 15% to 22% of dog bite wounds.

### Other Diagnostic Findings

#### Radiography

- Thoracic radiographs may be normal or may reveal pulmonary contusions, pneumothorax, or pneumomediastinum. Rib fractures may also be seen.
- Subcutaneous emphysema may be seen in cases of tracheal lacerations or punctures.
- Abdominal radiographs are usually normal, but free air seen in the abdomen is an indication of a hollow organ being ruptured or penetration of the abdominal cavity. Rarely, early signs of peritonitis may be detected.
- Fractures of various bony structures may be seen. In rare cases, a piece of tooth or dental calculus may be seen wedged between the radius and ulna.

#### Thoracic Fine-Needle Aspiration

- In animals that are exhibiting signs of pneumothorax or pleural effusion but are too unstable for radiography, fine-needle aspiration of both sides of the chest can be performed for diagnostic and therapeutic purposes.

### KEY TO COSTS

- $ indicates relative costs of any diagnostic and treatment regimens listed.
- $ costs under $250
- $$ costs between $250 and $500
- $$$ costs between $500 and $1,000
- $$$$ costs over $1,000

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**Editorial Mission:**
To provide busy practitioners with concise, peer-reviewed recommendations on current treatment standards drawn from published veterinary medical literature.

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can be used as a topical anesthetic. Mixing 0.1 ml of sodium bicarbonate with 1 ml of lidocaine makes the injection less painful. Once the lidocaine has taken effect, the puncture site can be explored with a sterile hemostat or a sterile cotton swab. Following exploration, the puncture sites should be evaluated daily and may need warm compresses or flushing in order to keep them clean and open.

- Initially, larger lacerations can be cleaned and lavaged; if vessels are hemorrhaging, they can be ligated at this time. The area can be appropriately bandaged to decrease infection and aid in debridement.

- The lesion should be flushed, ideally using a 35-ml syringe and an 18-gauge needle, which will yield approximately 8 psi. Such a low pressure will remove debris without forcing contamination into deeper tissue. The area should be copiously flushed with large amounts of sterile fluid.

  — Chlorhexidine 1:40 (25 mL/L of fluid) is an excellent flush solution because it is antibacterial, has good residual activity, and is active in organic material.

  — A 1:10 (1%) povidone–iodine solution can also be used but has poor activity in organic material. The stock solution of 10% povidone—

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
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<tbody>
<tr>
<td><strong>Opioids</strong></td>
<td></td>
</tr>
<tr>
<td>Morphine</td>
<td>0.5–2 mg/kg IV q2–4h</td>
</tr>
<tr>
<td></td>
<td>0.01–0.2 mg/kg/hr CRI</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>2–5 µg/kg/hr CRI</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>0.05–0.2 mg/kg IV q2–6h</td>
</tr>
<tr>
<td></td>
<td>0.012 mg/kg/hr CRI</td>
</tr>
<tr>
<td>Butorphanol</td>
<td>0.1–0.4 mg/kg IV q1–4h</td>
</tr>
<tr>
<td></td>
<td>0.1 mg/kg/hr CRI</td>
</tr>
<tr>
<td>Buprenorphine</td>
<td>0.005–0.02 mg/kg IV q8–12h</td>
</tr>
<tr>
<td><strong>NSAIDs</strong></td>
<td></td>
</tr>
<tr>
<td>Ketoprofen</td>
<td>2 mg/kg IV, SQ, IM once,</td>
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<tr>
<td></td>
<td>then PO q24h at a lower dose</td>
</tr>
<tr>
<td>Meloxicam</td>
<td>0.2 mg/kg IV or SQ once,</td>
</tr>
<tr>
<td></td>
<td>then PO q24h at a lower dose</td>
</tr>
<tr>
<td>Carprofen</td>
<td>4 mg/kg IV, SQ, IM once,</td>
</tr>
<tr>
<td></td>
<td>then PO q24h at a lower dose</td>
</tr>
<tr>
<td><strong>Combination CRI Analgesic</strong></td>
<td>0.1 mg/kg/hr (each) CRI</td>
</tr>
<tr>
<td>Morphine–Ketamine</td>
<td></td>
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</tbody>
</table>

For opioids, the dosages for cats are similar to those used in dogs. Readers are advised to refer to specific dosage schedules. About half the loading dose.

CRI = constant rate infusion.

Summary of Diagnostic Criteria
- A history of being in a fight with a dog or cat.
- Puncture wounds on the body.

Diagnostic Differentials
- Traumatic lesion from a penetrating object.
- Blunt trauma causing respiratory or neurologic signs.
- Systemic inflammatory response to bacteria.

TREATMENT RECOMMENDATIONS

Initial Treatment
- The most life-threatening finding should be treated first.
- Healing does not progress past the inflammatory stage; therefore remove all dead or infected tissue.
- Analgesics for mild or moderate pain include buprenorphine or butorphanol. For severe pain, a µ-agonist opioid should be used. Drug combinations and drug cocktails may also be helpful (Table 1).
- The area around the wound should be clipped liberally but gently. Before clipping the area, the laceration should be covered with a water-soluble gel or gel-coated gauze or saturated with sterile saline. For lesions on the face and around the eyes, an appropriate eye ointment should be used.
- The area should be gently cleaned without scrubbing. Warm water or saline and surgical soap should be used, making sure that the soap does not enter the wounds.
- Puncture wounds should be explored. Lidocaine (not to exceed 8–10 mg/kg, the toxic dose for dogs)
iodine should not be used to flush bite wounds because it does not contain enough free iodine to kill bacteria.

• The lesion should be debrided until all dead or infected tissue is removed. Tattered borders should be trimmed, and severely injured muscle tissue can be removed; any injured fatty tissue should be removed as well. If surgical debridement is not applicable, mechanical or chemical debridement can be used. Chemical debridement involves the use of products such as Granulex (Pfizer Animal Health) to remove nonviable tissue. Mechanical debridement involves the use of bandage material to remove unwanted debris. Bandages are composed of three layers (primary, secondary, and protective):
  — Primary layer: Current thought is to always keep the wound moist. It is important not to use too much moisture, which may cause normal skin or the dry wound edges to macerate. The moistened bandage will mechanically debride the wound of foreign material, necrotic tissue, and/or devitalized muscle. If debridement is not needed for a clean wound, it can still be kept moist under a bandage. The wet portion of the bandage is made by placing wet gauze sponges (normal saline or 1:40 chlorhexidine) on the wound or by placing dry sponges on the wound and then spraying or pouring fluid on them.
  — The secondary layer is bulky and is primarily for protection and absorption.
  — The protective layer is for support of the other layers.
• Bandages should be changed once or twice daily depending on the amount of exudate from the wound.

• Antibiotic use in bite wounds is controversial. With severe penetrating wounds, we recommend bacteriocidal systemic antibiotics (Table 2). Some studies have shown that infection is not a problem when good wound debridement and lavage are performed. Use of systemic antibiotics in such cases did not prevent infections. Other veterinarians recommend prophylactic antibiotics in the face of significant tissue trauma; cephalaxin achieves high concentrations in wounds. Regardless, antibiotics are not a substitute for good surgical debridement and lavage. Topical antibiotics can be used under the bandage before granulation tissue forms; water-soluble agents are the best choice (Table 3).

• Aggressive surgical intervention is indicated once the animal is stabilized and anesthesia can be used. The wounds should be opened maximally to ensure removal of any devitalized or infected tissue. Generally, the incision is made dorsoventrally in order to allow for ventral drainage. Puncture wounds must be opened so that tissue below the skin can be evaluated. Sharp dissection without the use of electrocautery is less likely to lead to further tissue damage and infection. In many cases, it may be difficult to determine the extent of a puncture lesion with only a hemostat or cotton swab.

• Large lacerated areas should be inspected for devitalized or infected tissue. The laceration can be sutured closed if the wound is clean and free of dead tissue. If a small number of monofilament sutures cannot decrease the dead space in the wound, drains may be used.

• Drains are primarily used to decrease dead space in a wound. Sometimes, they are used in contaminated wounds that cannot be cleaned with flushing or surgery. Most drains are left in place for only 3 to 5 days. They are considered to be either passive or active in nature. The Penrose drain is the most common passive drain. Since fluid drains around the Penrose, holes should not be cut in the tubing since it will decrease its surface area. Active drains are more expensive and bulkier, but since they are closed drainage systems, they do not allow ascending infections.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
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<tbody>
<tr>
<td>Amikacin</td>
<td>10 mg/kg IV or IM q12h</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>5–20 mg/kg IV, PO, or SQ q12–24h</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>15–35 mg/kg IV, IM, or SQ q4–8h</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>10–30 mg/kg IV, IM, or SQ q6–8h</td>
</tr>
<tr>
<td>Cephalothin</td>
<td>15–35 mg/kg IV, SQ, or IM q6–9h</td>
</tr>
<tr>
<td>Amoxicillin–</td>
<td>10–20 mg/kg PO q8–12h</td>
</tr>
<tr>
<td>Clavulanic acid</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>11–20 mg/kg SQ q24h</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>8–12 mg/kg IV or IM q24h</td>
</tr>
<tr>
<td>Imipenem</td>
<td>1–7.5 mg/kg IV or IM q6–8h</td>
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</table>

<table>
<thead>
<tr>
<th>Drug Type</th>
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<tbody>
<tr>
<td>Bacitracin–Neomycin–Polymixin</td>
</tr>
<tr>
<td>Silver sulfadiazine</td>
</tr>
<tr>
<td>Nitrofurazone</td>
</tr>
<tr>
<td>Petrolatum based</td>
</tr>
<tr>
<td>Water-miscible cream</td>
</tr>
<tr>
<td>Water-soluble dressing</td>
</tr>
</tbody>
</table>

**TABLE 2** Oral Antimicrobials for Animals with Bite Wounds

**TABLE 3** Topical Antibiotics for Animals with Bite Wounds
— If the puncture wound extends into the abdomen, abdominal exploratory surgery should be performed. Even in the face of blunt (crushing) abdominal trauma, bowel walls and vessels can be crushed or crimped. This can lead to necrosis of the bowel and leakage from the intestinal tract leading to peritonitis. Once established, peritonitis can be devastating, and in many cases it is better to open the abdomen than to simply wait.

— If the lesion is over the chest and the puncture wound has entered the thorax, mechanical ventilation may be necessary while the animal is under anesthesia. $$$

— Devitalized (black or white) muscle should be removed, leaving vital vascular and nervous tissue intact. Viable muscle usually bleeds or will twitch when manipulated. If doubtful, it may be better to leave the muscle and debride the area daily in order to preserve any tissue that may be viable. Devitalized tissue can always be removed at a later time. Some surgeons remove doubtful viable muscle since functionality is rarely lost.

— Fatty tissue of questionable vitality should be removed.

— Tissue should be flushed at low pressure and repaired using the fewest number of sutures possible. Using small (4-0) monofilament suture helps prevent a nidus for infection.

• Closure of an aseptic wound is considered to be a primary intention healing. If the wound is left open for adequate drainage and debridement and is closed at a later time when it is aseptic, it is referred to as delayed wound closure. Secondary intention healing is due to contraction and epithelialization of a wound that is left open and not sutured.

### Alternative/Optional Treatments/Therapy

• Chest tubes are indicated for patients with severe pneumothorax.

• Drainage tubes may be needed to decrease dead space or, in some cases, to allow for debris removal. Drains can be active or passive and are usually left in place for 3 to 5 days. Active drains decrease the likelihood of ascending infections but are more cumbersome and more expensive. Passive drains, such as a Penrose drain, can be used to decrease dead space. Generally, only one ventral skin exit site is made, and it should not be through the puncture site.

### Supportive Treatment

• Crystalloid fluids or colloids may be used for patients in shock. Such animals should be monitored continually and rate of fluid administration adjusted accordingly. Maintenance fluids (balanced isotonic crystalloid or low-sodium maintenance crystalloid) may be used in patients that are not eating or drinking. Maintenance fluid rates vary from 53 to 66 ml/kg/day.

• Parenteral or enteral nutrition is also important for daily metabolic needs. The calorie formula for resting energy requirement (RER) is:

\[
\text{kcal/day} = 30 \times \text{kg} + 70
\]

or for an animal weighing <2kg

\[
\text{kcal/day} = \text{kg} \times (70)^{0.75}
\]

• Simplified guidelines are as follows:
  — Adult dogs: 15 kcal/lb/day.
  — Adult cats: 20 kcal/lb/day.
  — Animals weighing <5 lb: 25 kcal/lb/day.

### Patient Monitoring

• The wound should be checked once or twice daily for changes in color, temperature, and odor. The amount and color of any discharge from the wound and the bandage should be recorded daily.

• A complete blood cell count and changes in body temperature can be used to evaluate the inflammatory response.

• Culture and sensitivity testing should guide clinicians as to which antibiotic is best.

### Home Management

• By the time an animal is sent home, most of the major care has been accomplished. Owners may
need to observe drains for discharge to make sure the drain is working sufficiently. If antibiotics and/or analgesics are sent home with the animal, owners need to follow administration instructions. Puncture sites should be monitored for swelling, redness, and pain.

Milestones/Recovery

**Time Frames**
- The amount of healing time needed depends on the severity of the lesion.
- Wounds should be examined and bandages changed daily to evaluate contamination. Once free of contamination, larger wounds may be closed surgically.

**Treatment Contraindications**
- Cortisone is contraindicated because of its potential to decrease resistance to bacterial infections and to allow systemic disease to occur.
- Tourniquets are contraindicated for traumatized tissue, even if bleeding appears profuse to the owner. Tourniquets can cause more vascular injuries to a compromised animal, as well as neurologic damage and muscle ischemia. Compression with a towel or other material to decrease bleeding is more appropriate.

**PROGNOSIS**

**Favorable Criteria**
- Wounds are healing and the animal is not in pain.
- Absence of discharge.
- Absence of swelling and redness.

**Unfavorable Criteria**
- Signs of local infection: redness, swelling, warm to the touch, and pain.
- Turbid wound discharge with a putrid odor.
- Signs of systemic sepsis: shock, hypotension, degenerative to left shift, and hypoglycemia.

**RECOMMENDED READING**


