Association of Primate Veterinarians Guidelines for Wound Management of Nonhuman Primates

Purpose

The Association of Primate Veterinarians recognizes that injuries occur periodically in nonhuman primates (NHP) in social housing as well as in single housing settings. This document describes the types of wounds typical to NHP, therapeutic approaches, and considerations to reduce the occurrence of wounds. These guidelines were developed to provide veterinarians and animal caregivers with NHP-specific information on wound management in these species. These guidelines are not meant to address general veterinary wound management principles, but to emphasize issues unique to wound management in NHP.

Background

Wounding risks inherent to social housing of NHP can be reduced by appropriate behavioral assessment and cage enhancements rather than through elimination of social housing as a management strategy. Social housing should be overseen by trained individuals with knowledge of species-specific behavior, as animals housed socially require ongoing monitoring to ensure compatibility and to reduce the possibility of injury. It is important for veterinarians, researchers, animal care staff, and institutional animal care and use committees to recognize that wounding is a potential sequela of providing appropriate social enrichment and housing to these animals.

Injuries may occur in established NHP groups when there is social instability, during animal introduction attempts or as a result of the animal’s environment. Intraspecies aggression between animals housed in social groups is most common during the breeding season of seasonal NHP species, during the formation of new social groups, or introduction of unfamiliar animals into existing social groups. Injuries may also occur as a result of ambient environmental conditions that may be difficult to control in outdoor housed animals. NHP housed indoors may present with wounding due to injury from partners, particularly during initial pairing attempts.

Animals display varying types of injuries including lacerations, punctures, abrasions, maceration of distal extremities, and crushing injuries. In species with notable sexual dimorphism and elongated canines in males, deep penetrating lacerations caused by the cutting edges are likely to be readily recognizable. Staff should be appropriately trained to identify more subtle injuries such as deep punctures from tips of male canine teeth, and abrasions or contusions as is typical with female-pattern trauma, both of which can result in minor skin involvement, but cause severe damage to underlying tissues.

Guidelines

Specific Wound Types

Crush Injury.

Crush trauma may result in potentially life-threatening rhabdomyolysis that develops from repeated bites from animals with short canine teeth (females and juveniles). While the outward appearance is superficial skin trauma with potential bruising or swelling, the underlying muscle damage can be extensive and severe with systemic release of intracellular contents, such as myoglobin, lactic acid, and potassium. Dark urine (myoglobinuria) or anuria may be noted in cases of severe injury or delayed treatment. Potentially fatal complications of crush trauma and subsequent rhabdomyolysis include hypovolemic shock, acute kidney injury, and hyperkalemia. Diagnosis of rhabdomyolysis can be made with evidence of wounding, presence of elevated serum CK and AST, and myoglobinuria in the absence of hematuria. Severe myonecrosis may also be visualized via ultrasonography. Early intensive volume expansion therapy may correct hypovolemia and prevent acute kidney injury. It is important to consider the use of colloidal as well as crystalloid fluid therapy. Crystalloids may redistribute to the interstitial space, exacerbating development of compartmental syndrome. Other treatment methods should focus on prevention or mitigation of the effects of myoglobin crystal formation, and antibiotic and analgesic therapy with particular care to avoid nephrotoxic agents. Indicators of acidosis (venous blood pH, bicarbonate, base excess, and lactate levels) have been shown to be indicative of survival in rhesus macaques presenting with rhabdomyolysis. In particular, two or more indicators of acidosis at clinical presentation suggest a guarded to poor prognosis; elevated lactate levels remain a predictive factor of mortality after fluid resuscitation therapy. Pregnant patients should have fetal viability evaluated throughout the course of treatment, as the prognosis for fetal survival is poor.

Degloving.

Degloving soft-tissue injuries characterized by avulsions or detachment of skin and subcutaneous tissue from underlying muscle and fascia can occur to the head, flank, or extremities of NHP resultant from a sudden shearing force from conspecific aggression or complications from housing structures. Degloving wounds with concurrent deep soft-tissue injury typically have higher rates of perioperative complications, surgical intervention, and amputation. Delay of initial treatment may increase the risk of infection or progression to necrotizing fasciitis. Attempts at preservation of avulsed tissue is justified to minimize future interventions, although partial loss of this tissue is expected. Further surgical intervention such as skin flap, graft, delayed primary closure, or secondary closure options may be required. Care should be taken throughout management to preserve limb function with passive range of motion and other physical therapy techniques.

Frostbite.

Frostbite in NHP may occur when skin is exposed to extreme cold with distal extremities or other areas of reduced hair being the most susceptible sites. Frostbite severity and tissue injury is a result of not only extreme cold temperatures, but duration of exposure. Because water is a more efficient thermal conductor than air, exposure to standing water, slush, or snow can quickly exacerbate cold injury. If frostbite occurs, the goals of treatment are removal from the cold, rewarming frostbitten areas, and prevention of complications. The affected part is rapidly rewarmed by submersion in a water and antiseptic mixture (37 to 42 °C). Rewarming can be acutely painful and multi-modal analgesia should be used. Rubbing or massaging affected areas should be avoided to prevent further damage to tissue. Favorable prognostic indicators are the appearance of healthy
skin or clear blisters and a rapid response to tactile stimulation of the affected area. Demarcation of non-viable tissues can take weeks to develop. The potential for damaged tissue to recover should be considered if debridement or amputation is required. In humans, if the affected area recovers, long term complications include chronic pain unresponsive to conventional analgesia, cold sensitivity, and sensory loss. Management of frostbite cases may be prolonged and can take months to heal. Additional potential complications for NHP with frostbite include wound infection, rhabdomyolysis, tetanus, and a greater risk of subsequent cold-related injury. Frostbite should be prevented by implementation of housing practices that avoid temperature extremes and provide protection from cold, wind, and moisture.

### Bandaging

Standard three-layer bandage techniques utilized across veterinary medicine of a primary contact dressing, secondary absorptive layer, and tertiary outer layer can be modified when applied to NHP, with the main consideration being the ability to manipulate and remove bandages with greater ease than most other veterinary patients. Various methods can be utilized to reduce or prevent bandage removal or tampering by the patient such as extending bandages across the torso, pinning to the table, and using cold-snap ties. Bandages applied too tightly may cause vascular compromise, necrosis, and require surgical intervention. However, lidocaine onset times have been used in combination with lidocaine in attempts to achieve faster onset of local anesthesia. Addi- cional anesthetic with buprenorphine or epinephrine may increase analgesia.

### Analgesia

Many NHP show little reaction to painful wounds, and signs of pain may not be evident unless there is severe injury. Analgesics should be given immediately for wounds with emphasis on multimodal pain control. Pain-relieving drugs should not be withheld or underdosed as a means to deter suture picking or bandage removal. Opioids or NSAIDs may be given alone or in combination. Commercially available sustained-release or highly concentrated versions of meloxicam and buprenorphine are thought to provide more than 24 hours of analgesia, but may be associated with localized complications at the injection site if specific instructions for injection technique are not followed. Local anesthetics provide additional pain relief when administered as splash blocks into open wounds, or as anxiolytic medications. Plastic syringe caps with holes for air exchange can be used to cover tail tip injuries. When bandage tampering does occur, exposed digits or tails should be carefully assessed for signs of constriction from underlying bandage layers. If NHP are not trained for conscious manipulations either by presentation of the injured area or chained restraint, the frequency of bandage changes should be considered in regard to number of sedation events and stage of wound healing. Bandaging should not be a criterion for single housing. In the authors’ experience, social housing does not necessarily increase the incidence of bandage tampering by the patient or its cage mates.

### Special Considerations

Analgesia.

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### Alternative Methods of Wound Healing

**Skin Grafts.**

Skin graft techniques are often used to cover large skin deficit wounds with minimal tension and suitable cosmetic results when mobilization of skin is challenging, such as for extremities. Xenograft and allograft skin transplantation can provide a temporary protective wound covering for large skin defects and has been previously described in NHP. Autologous skin graft techniques allow for permanent reconstruction when other primary closure or skin flap reconstruction options have failed or are impractical. Descriptions of both full-thickness (FTSG) and split-thickness skin grafts (STSG) in veterinary species have indicated a high overall complication rate with anatomic location and skin adhesion-induced sloughing as contributing factors. Stabilization of graft tissue can be achieved with peripheral application of skin adhesive for FTSG and subcutaneous tacking and peripheral sutures for STSG. Once stabilized, a sterile, nonadherent dressing material should be applied over graft sites to provide a moist, protective environment, as any disruption within the first five days will damage formation of vascular anastomoses resulting in graft failure. While STSG is more consistently successful compared to FTSG, it also carries the higher potential of long-term complications such as contraction of graft/recipient beds, graft fragility, and poor cosmetic appearance due to lack of hair regrowth.
In the authors’ experience, skin graft techniques in NHP can be technically challenging due to friability of graft tissue and complications of bandaging.

Laser Therapy.

The use of low-level laser therapy (LLLT) in wound healing has been described in animals and humans. Reported positive effects include stimulation of angiogenesis, augmentation of collagen synthesis, increased tensile strength, diminution of wound size, and reduced healing time. However, the few randomized, controlled trials on treatment of chronic wounds collectively provide variable and inconclusive evidence of its efficacy. LLLT therapy remains controversial as a therapy due to poorly understood biochemical mechanisms and a wide variety of recommended operation parameters. Use of LLLT in NHP can be used to promote tissue healing, reduce inflammation, and alleviate pain from wounding. Given that effectiveness of treatment may require repetitive treatments over a prolonged time, use of positive reinforcement training can facilitate the treatment of NHP with therapeutic laser while in their home enclosures to optimize wound care and minimize anesthesia.

Preventative Management

Entrapment.

The risk of animal or limb entrapment increases with the desire to provide appropriately complex housing environments to meet requirements of environmental enhancement plans for NHP, particularly in facilities with animal movement doors utilizing mechanical controls such as hydraulic or pneumatic mechanisms. Prior to implementation, all housing structures and enrichment devices should be thoroughly evaluated to ensure that items are free of sharp edges and openings that could lead to entrapment. Enrichment should be distributed in a manner so as to preclude animals from reaching through an opening to procure the desired item. When opening or closing animal access doors, staff should ensure that animals are not physically present in the door space and should be prepared to stop door closure if an animal unexpectedly approaches during operation. Similarly, extra care should be taken when reducing the available cage space, placing cage dividers, and removing animals with particularly long tails from caging (for example, Macaca fascicularis, Cercocebus spp., Saimiri spp.) during restraint procedures. Should entrapment of an animal or appendage occur, a full examination is recommended to evaluate potential sequelae. Potential complications of entrapment may include laceration or crushing traumatic injuries, orthopedic injury, and nerve damage.

Blunting of Male Canines.

In accordance with previous policy statements by the USDA Animal and Plant Health Inspection Service and the American Veterinary Medical Association, APV does not endorse reduction or extraction of canine teeth in NHP unless required for medical treatment or approved scientific research. Coronal reduction or “blunting” of canine teeth is sometimes performed with the misguided goal of reducing injury and wound severity to other primates or handlers, but it is important to note that wounding can still be caused by reduced or blunt teeth. In large group settings, blunting has been associated with reduction in deep muscle or tendon injury, but not a reduction in skin lacerations. Tooth compromise requiring extraction is a common consequence of canine blunting in NHP due to complications of thermal damage to the pulp or exposure of dentin. Adult male rhesus are seven times more likely to require canine tooth extraction within 18 months post-blunting than with unmanipulated teeth. Normal occlusion of the canines sharpens the teeth post-blunting in some animals as will active tooth honing. To minimize injury, recommended alternatives to dental surgery include behavioral assessment and modification, environmental enrichment, changes in group composition, and improved animal housing and handling techniques.

References

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