JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE

Wound Management (K9CPG:14)

This CPG provides guidance on treatment of open wounds in military working dogs.

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SUMMARY OF CHANGES

1. Removal of 6-hour timeline for categorization of contaminated and dirty/infected wounds.
2. Clarification of acceptable use of tap water for wound lavage.
3. Expanded definition of lavage into low-pressure and high-pressure methods and updated lavage volume guidelines.
4. Removal of wet-to-dry bandages as the standard of care.
5. Addition of concept of moist wound healing and types of moisture retentive dressings, with inclusion of a table that summarizes the characteristics and indications for each dressing.
6. Removal of topical silver sulfadiazine ointment over the wound and using dressings impregnated with ionic or nanoparticle silver instead.
7. Removed recommendation to culture wounds at initial presentation.
8. Removed ciprofloxacin as suggested empirical antibiotic treatment.
9. Added wound photos.

BACKGROUND

Wounds commonly result from ballistic injuries, bites, motor vehicle trauma, or other trauma. In most cases, traumatic wounds can be classified as contaminated or dirty/infected wounds. It is no longer considered appropriate to attribute a set time frame to differentiate between these two categories of wounds but instead consider factors such as location of the wound (e.g., head wounds that are very vascular tend to heal well even after longer periods of time from initial injury), size of the wound, and overall health of the patient to determine if primary closure is appropriate.

Wounds are often noted in conjunction with potentially life-threatening injuries; thus, in all MWDs presenting with wounds, a detailed systematic triage examination and a careful search for – and management of – more severe concurrent injuries must take precedent over management of wounds. In all instances, wound care follows resuscitation and stabilization of the patient.

CONSIDERATIONS IN WOUND MANAGEMENT

The primary goal in wound management is to facilitate wound healing without development of a wound infection. A healthy wound bed is one that has adequate blood supply to support repair, without contamination or necrotic tissue that will impede healing and increase the risk of infection.

Unless simple and small, many wounds will require frequent evaluation, generally at least once daily. Evaluation frequency will be based on location, extent, severity, and other factors. Many wounds will need to be managed as open wounds, protected by bandages, before definitive surgical repair.

The steps in daily wound evaluation are to:

1. Assess the response to or need for antibiotics.
2. Debride necrotic tissues and lavage the wound.
3. Assess for surgical closure.
4. Protect the wound.

INITIAL WOUND MANAGEMENT RECOMMENDATIONS[1-11]

Provide effective analgesia or anesthesia (see K9 Analgesia and Anesthesia) based on wound severity, location and other factors. See Table 1.[1-7]

1. The goal of initial lavage is to remove gross contaminants and reduce bacterial burden.
    - Apply sterile water-soluble lubricant liberally on the wound bed and then clip the hair with wide margins around the wound.
    - Gently cleanse the skin around the wound, but not the wound bed, with surgical scrub (such as chlorhexidine gluconate or povidone-iodine).
    - Gently lavage the lubricant and gross contaminants from the wound using a sterile isotonic solution (such as normal saline or Lactated Ringer's Solution). Tap water can also be used in austere conditions for wound lavage to remove debris when saline or LRS is not available, as studies have shown no increase in wound infection rate when compared to saline.[8]
2. Debride grossly necrotic tissue and non-viable tissue (see Figure 1) carefully using aseptic technique and sharp dissection with a scalpel blade or scissors. Do not mass ligate tissues or use excessive cautery – this leads to necrosis. Use caution not to damage, transect, or ligate major blood vessels (unless active hemorrhage) or nerves.

Figure 1. Example of appearance of non-viable skin tissue in a dog following a bite wound injury.

3. Lavage of the wound is necessary to remove debris and reduce bacterial contamination. The solution to pollution is dilution.
    - Low pressure, high-volume irrigation with bulb and syringe or gravity irrigation with large bore tubing are common options for wound irrigation.
        - 7 – 8 psi is recommended for wound irrigation and can be achieved by placing a 1-liter bag of fluids in a pressure cuff at 300 mmHg and attaching a hypodermic needle (16 to 22 gauge) to an extension line.[5]
    - High pressure irrigation with pulsatile jet lavage irrigation may be available and can reduce bacterial contamination but can also result in tissue damage.[9]
    - A standard volume for irrigation is not reported, but a general guideline reported in literature is 50 to 100 mL per centimeter of wound length.[10]
        - For wounds involving open fractures, common volumes include approximately 3 liters for Type I fractures, and 3-6 liters for Type II and III fractures, sometimes using as much as 9 liters for Type III fractures.[11]
4. Generally, contaminated and dirty/infected wounds should not be sutured until healthy granulation tissue is established, in about 3 to 5 days. This is especially true for bite wounds.

Table 1. Management of open or necrotic wounds in MWDs.

MANAGEMENT OF OPEN OR NECROTIC WOUNDS IN MWDS
1. Manage potential local and systemic infection.
▪ Initiate antibiotic therapy as soon as possible after injury. See Table 3.
▪ Culture the wound if obvious infection develops during any phase of wound management, if the wound fails to heal normally, or if systemic signs of infection develop.
2. Provide initial wound management.
▪ Provide effective analgesia or anesthesia based on wound severity, location, and other factors. (See K9 Analgesia and Anesthesia.).
▪ Apply sterile water-soluble lubricant to the wound bed and then clip the hair wide around the wound.
▪ Cleanse the skin around the wound (not the wound bed) with surgical scrub.
▪ Lavage the lubricant and gross contaminants from the wound using sterile saline or LRS.
▪ Debride grossly necrotic tissues using aseptic technique and sharp dissection.
▪ Lavage wound to remove debris and reduce bacterial contamination.
3. Bandage the wound.

MANAGEMENT OF OPEN OR NECROTIC WOUNDS IN MWDS
▪ Apply primary layer directly to the wound to provide moist wound healing environment.
▪ Apply secondary layer using cast padding or roll cotton +/- splints.
▪ Apply tertiary layer of non-adherent conforming bandage, adhesive bandage or both using light compression.
▪ Apply a tie-over bandage in areas that are not amenable to routine bandaging.
4. Provide daily wound care using appropriate analgesia, sedation or anesthesia.
▪ Change bandages daily, but more frequently if heavy discharge is present or the bandage is soiled or partially removed by the MWD. As the wound heals and discharge decreases, some wounds may no longer require daily bandage changes.
▪ Lavage the wound at every bandage change.
▪ Debride the wound (if needed) at every bandage change.

BANDAGING RECOMMENDATIONS

In nearly all cases, open wounds should be bandaged to protect the wound from contamination and support the wound while it heals. In most cases, mechanical debridement of the wound bed is desired in the early stages of wound healing, prior to the formation of granulation tissue. In a compromised patient where anesthesia and surgical debridement are not possible, moist wound healing provides a safe means of wound debridement until the patient is more stable.

BANDAGE COMPONENTS

Primary Layer

Moist wound healing is the standard of care for wound management. Wet-to-dry bandages (adherent) are no longer recommended due to the indiscriminate debridement which compromises wound healing.

If non-surgical debridement is needed during early wound care (in presence of contamination and infection), hyperosmotic agents such as hypertonic saline dressings or honey can be used.

The current standard of care for open wound management is moisture retentive dressings (MRD). They facilitate debridement, granulation tissue formation and epithelialization and are applied directly to the wound.

Select the most appropriate MRD based on anticipated exudate production. See Table 2 for basic dressing guidelines.

Use aseptic technique when handling the MRD. Prior to placing the MRD on the wound bed, ensure that the dressing does not extend over the intact skin to prevent maceration. Consider the depth and shape of the wound when selecting the dressing.

For infected wounds, nanoparticle slow-release, silver-impregnated dressings and ionic silver-impregnated dressings show superior effectiveness. The hydrophilic silver-impregnated dressings release ionic silver into the gel that is produced at the wound exudate-dressing interface which provides consistent antimicrobial activity against a range of aerobic and anaerobic bacteria, including antibiotic-resistant strains, yeasts and filamentous fungi. If these dressings are not available, a non-adherent pad with antibiotic ointment (e.g. a combination of bacitracin zinc, neomycin sulfate, and polymyxin B sulfate) can be used on most wounds.

Table 2. Common moisture retentive dressings.

MOISTURE RETENTIVE DRESSING	WOUND EXUDATE LEVEL	PROPERTIES	INDICATIONS
Calcium alginate	Moderate to high	Made from seaweed. Soft, felt like material that absorbs wound fluid. Calcium promotes hemostasis.	Absorbs exudates and keeps wound surface moist, enhances autolytic debridement, promotes granulation tissue formation.
Polyurethane foam	Moderate	Soft, thick foam. Does not form a gel. Keeps proper moisture level on wound surface.	
Hydrocolloid	Low to moderate	Sheet, paste, or powdered forms. Turns into a gel as it absorbs fluid. Sheets usually have occlusive backing.	
Hydrogel	Low to none	Product is an amorphous gel or sheet that turns into a gel in the wound. Hydrogel impregnated dressings.	Dry wounds requiring autolytic debridement, granulation, or epithelialization. Provides exogenous moisture; wounds with minimal to no exudate, especially partial-thickness wounds (abrasions); keeps wound surface moist and promotes epithelialization.

Secondary Layer

Apply a secondary layer over a primary layer. Most commonly, rolled cast padding or roll cotton is used to provide support. Splints can be included in the secondary layer, if used.

Tertiary Layer

Apply a tertiary layer, typically consisting of a non-adherent conforming bandage, adhesive bandage, or both. This layer holds the dressing and secondary layer in place, provides additional support, and provides more durable protection of the underlying layers. In most cases, the tertiary layer is applied just tight enough to hold the bandage in place, and without compression.

TIE OVER BANDAGE

A tie over bandage (see Figure 2 below) should be used in locations that are difficult to place a bandage, such as the inguinal area, dorsum, hip and flank. Routine bandages placed in these areas typically slip off and fail to protect the wound. A tie over bandage consists of the same layers of bandage material placed within and over the wound.

Multiple suture loops are placed around the periphery of the wound in the skin, evenly spaced around the wound, using large (2-0 or larger) monofilament suture material (preferably non-absorbable). The bandage over the wound is then covered with a portion of impermeable drape or similar material. The entire bandage is then secured using umbilical tape or similar material laced through the suture loops in a shoelace-type crossover pattern. Ties of surgical masks are a good substitute if umbilical tape is not available. The ties should be sufficiently tight to hold the bandage in place, with mild tension on the suture loops. The covering layer should be snug over the top of the underlying layers. Adhesive material, such as Ioban™, can be used to secure tie over bandages in place of suture loops and ties.

Figure 2. Example of a tie over bandage.

BANDAGE CARE

Change bandages at least once daily. More frequent bandage changes may be necessary if the wound has heavy discharge, or the bandage becomes soiled or partially removed by the MWD. Once wound discharge is reduced and a healthy granulation bed has formed, bandage changes become less frequent, generally every 2-3 days.

Any MWD with a bandage applied must be prevented from chewing at the bandage. An e-collar or plastic bucket with the bottom cut out can be used to prevent self-trauma and is attached to the dog's collar as an effective prevention practice.

NEGATIVE PRESSURE WOUND THERAPY

Negative pressure wound therapy (NPWT) has proven a viable treatment modality for wounds in dogs. Consultation with a veterinary surgeon will ensure appropriate application and management. Heavy sedation of the MWD to prevent disruption of the dressing is sometimes required. See Figure 3 and Figure 4. In most cases, application of NPWT can be delayed until the MWD is medically evacuated to a Role 3 veterinary facility or out of theater for long-term care. If NPWT is applied, -125 mmHg on a continuous mode is the typical setting for open, granulating wounds

Figure 3. Wound bed ready for application of negative pressure wound therapy in a canine.

Figure 4. Negative pressure wound therapy applied to a wound in a canine.

ANTIBIOTIC USE WITH OPEN OR NECROTIC WOUNDS

Systemic antibiotics are indicated for any MWD with moderate or severe wounds.

Cultures should be collected if obvious infection develops during any phase of wound management, if the wound fails to heal normally, or if systemic signs of infection develop.

It is not recommended to culture fresh bite wounds, burns or trauma within 24 hours of the occurrence, as the cultures cannot predict whether microbes identified from these fresh wounds will cause infection. Wound cultures are indicated at admission only if the patient presents with an infected wound.

Continue antibiotics for a minimum of 7 days. See Table 3 for empirical antibiotic selection options for MWDs. If culture and sensitivity results are available, determine antibiotic therapy accordingly.

Table 3. Antibiotic selection and dosing for MWDs.

ANTIBIOTIC	DOSE	ROUTE	FREQUENCY
Amoxicillin	20 – 30 mg/kg	PO	Q 12 h
Ampicillin	20 – 30 mg/kg	IV	Q 8 h
Amoxicillin-Clavulanic Acid	13.75 mg/kg	PO	Q 12 h
Ampicillin Sulbactam	20 – 30 mg/kg	IV	Q 8 h
Cephalexin	30 mg/kg	PO	Q 12 h
Cefazolin	20 – 30 mg/kg	IV	Q 8 h
Cefotaxime	22 mg/k/g	IV	Q 8 h
Ceftriaxone	25 mg/kg	IV	Q 8 – 12 h

PERFORMANCE IMPROVEMENT (PI) MONITORING

POPULATION OF INTEREST

All MWDs with an open wound.

INTENT (EXPECTED OUTCOMES)

- Recovery from wound.
- No identified antibiotic resistance bacteria.
- Proper documentation of wound treatment in the MWD medical record.

PERFORMANCE / ADHERENCE MEASURES

- Number and percentage of patients in the population of interest (deployed MWDs) that sustained an open wound injury.
  - Number of MWDs that received primary closure for the wound.
  - Number of MWDs that received delayed closure (either secondary or tertiary).
    Length of time before closure (secondary) or complete healing (tertiary).
- Number and percentage of MWDs that returned to duty.

DATA SOURCE

- Patient Record
- Department of Defense MWD Trauma Registry

SYSTEM REPORTING & FREQUENCY

The above constitutes the minimum criteria for PI monitoring of this K9 CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by direction of the K9C4 Chair.

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APPENDIX A: CLASS VIII MEDICAL MATERIEL

K9 Wound Management: This is intended to be a resource for CPG-directed wound care (initial lavage/debridement, bandaging, dressing changes, culture collection, and advanced therapies)

Basic Cleaning & Irrigation

- Sterile normal saline (0.9% NaCl) or Lactated Ringer's Solution (LRS) - multiple liters
- Bulb syringe(s)
- Large-bore gravity irrigation tubing/bags (IV tubing adapted for gravity irrigation)
- Optional: Pulsatile (battery) lavage device & spare batteries

Wound Preparation & Clipping

- Water-soluble sterile lubricant (surgical lubricant) - liberal use to protect wound bed during clip/clean.
- Electric clipper with sterile blades.
- Surgical scrub solutions (chlorhexidine or povidone-iodine)

Debridement & Minor Operative Supplies

- Scalpel handles & blades (various sizes) - sharp debridement.
- Metzenbaum/mayo scissors - dissection and debridement.
- Hemostats/forceps (Brown-Adson, Debakey, mosquito) - tissue handling.
- Sterile drapes/impervious drape material
- Monofilament suture (2-0 and larger) for tie-over bandages
- Umbilical tape/surgical mask ties

Bandage Materials & Dressings

- Sterile gauze sponges (4x4 or similar)
- Laparotomy sponges - for large wound primary packing
- Non-adherent dressings (e.g., Telfa pads).
- Topical agents:
  - Moisture retentive dressings (e.g., calcium alginate, polyurethane foam, hydrocolloid, hydrogen)
  - Triple-antibiotic ointment (bacitracin/polymyxin/neomycin)
- Roll cotton/cast padding (soft roll)
- Conforming gauze/elastic conforming bandage
- Adhesive tape (paper/waterproof surgical tape)
- Sterile gloves (various sizes), gown, masks
- Adhesive spray/skin prep (optional) (e.g., DuraPrep™)

Advanced Wound Care & Adjuncts

- Negative pressure wound therapy (NPWT) device kit (e.g., WoundVac) and canisters. CPG recognizes NPWT as viable but requires training and frequent sedation; recommended to consult veterinary staff.
- Splinting materials (if wound requires immobilization) and padding.

Analgesia, Anesthesia & Sedation (for Debridement/Bandaging)

- Analgesics/sedatives appropriate for MWDs (opioids, alpha-2 agonists, ketamine, benzodiazepines, reversal agents where applicable) - per CPG advise to provide effective analgesia/anesthesia based on severity. (See K9 Analgesia and Anesthesia for more detailed anesthesia guidance.)
- Local anesthetics (lidocaine 1% or 2%) and syringes/needles
- Airway & oxygen supplies if general anesthesia/sedation is used (oxygen, ET tubes, laryngoscope)

Systemic Antibiotics & Other Medications

A formulary of systemic antibiotics appropriate for dogs and dosing references. (The CPG states systemic antibiotics are indicated for moderate/severe wounds and recommends continuing at least 7 days; consult Table 3 antibiotic guidance). Do not administer without veterinary oversight.

Miscellaneous & Patient Protection

- Elizabethan collar alternatives (bucket collar, “cone” or improvised plastic bucket with bottom cut out) to prevent chewing at bandage.
- Towels/blankets for positioning and to minimize patient movement during procedures
- Sharps containers and biohazard waste bags
- Documentation forms/wound tracking flow sheets (for daily evaluation and bandage change tracking)

For additional information including National Stock Number (NSN), please contact dha.ncr.med-log.list.lpr-cps@health.mil

***DISCLAIMER**: This is not an exhaustive list. These are items identified to be important for the care of combat casualties.*