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Open Wound Care

Approaches used in open wounds are moist and wet-to-dry techniques. These are not mutually exclusive; often both are used during the course of healing. Some experts are proponents of using moist technique throughout healing; others support their use only in clean, noncontaminated wounds to prevent infection. As there is no veterinary research to end the debate, practice is based on preferences and human research findings. Exudate levels and the needs of the wound should be assessed at each bandage change to ensure that the proper dressing is selected for the next bandage.

Types of Approach

Wet-to-Dry Bandaging

Evaporation from the bandage draws wound fluid through the bandage via creation of an osmotic gradient and also wicking action. This action bathes the wound with fluid, promoting healing because of exposure to nutrients, growth factors, and cytokines. As the gauze contact layer dries, the surface of the wound adheres to the gauze; subsequent removal of the gauze at the next bandage change physically debrides the wound.

- Wet-to-dry bandaging is an aggressive debriding technique. While this type of bandaging rapidly removes large amounts of loose necrotic debris and foreign matter from the wound surface, it is also nonselective—viable fibroblasts, capillary endothelial buds, epithelium, and leukocytes are also removed from the wound surface at each bandage change.

Moist Wound Management (Occlusive Dressings)

The creation of a wound initiates a complex interaction of cells, growth factors, cytokines, and proteases that is tailor-made for healing. The cells and proteins involved function best in



Cat with wet-to-dry dressing

a moist environment. Moist wound healing provides a wound environment that supports the body's own healing processes by maintaining a proper level of moisture during each stage of healing. Purported advantages of moist wound management include the following:

- Autolytic debridement by intrinsic white blood cells and proteases, which selectively target nonviable tissue, leaving undamaged tissue and new repaired tissue unharmed. This is in contrast to wet-to-dry bandaging, which indiscriminately removes both viable and nonviable tissue.
- Increased viability and enhanced function of cells and proteins in the moist, warm, physiologic environment are provided by an occlusive dressing.
- The occlusive dressing traps the cells needed for healing in the wound. With gauze, cells can migrate into the open weave and be unavailable for debridement or repair.

- Infection rate is lower with moist wound dressings in humans than with conventional dressings such as gauze because occlusive dressings:
 - Prevent desiccation and necrosis, which provide media for bacteria
 - Improve function of white blood cells and proteases
 - Stimulate repair processes (eg, angiogenesis, collagen synthesis)
 - Result in higher wound levels of systemic antibiotics
 - Provide a barrier to exogenous bacteria
 - Are changed less often, thereby decreasing exposure to exogenous bacteria.
- Dressings generally remain comfortable during wearing and removal—they are flexible and nonadherent, and wound fluid may soothe nerve endings.

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- Significantly less aerosolization of bacteria occurs during removal of a moist dressing than during removal of a dry dressing.
- Less frequent bandage changes are needed with moist wound management compared with wet-to-dry bandaging, thereby maintaining the desirable moist, warm wound environment for long intervals.
- Overall cost for wound management is lower in human patients for moist wound management than for wet-to-dry bandaging (even though the cost of occlusive dressing is higher than that of gauze) due to faster healing, longer intervals between bandage changes, and less need for sedation during bandage changes. Of course, wet-to-dry dressings are used for debridement and are considered short-term dressings, while occlusive dressings are used to promote epithelialization so are more long-term.
- Incidence of scarring is lower.
- Exposure of wound to external contaminants is reduced because dressing is waterproof and interval between bandage changes is increased.

Pain Index

Wet-to-Dry

Due to the extensive interdigitation of the contact layer and the wound surface, removal of wet-to-dry bandages can be painful for the patient. However, pain can be reduced through application of the following techniques:

1. Soak the layer of skin that comes into contact with the gauze with sterile isotonic fluids at body temperature before removal. This practice may, to a degree, reduce the effectiveness of debridement.
2. If soaking alone is insufficient, apply 2% lidocaine-sodium bicarbonate to the gauze contact layer after soaking the gauze with isotonic fluids, about 3 minutes before gauze removal. The lidocaine-sodium bicarbonate should be mixed at a ratio of 9:1 by volume (this prevents the stinging sensation of lidocaine alone) and warmed to body temperature before application.

Moist Wound Management

With moist wound management products, because the contact layer does not adhere to the wound, removal of the contact layer should be

more comfortable for the patient than with the wet-to-dry technique. However, remember that moist wound management often requires lavage at substantial pressure (7 to 9 psi) to dislodge and flush away foreign matter and necrotic debris, particularly if they are trapped in a thick gel layer, such as with alginate products. Many patients have a reaction to the lavage similar to that of removal of wet-to-dry gauze, indicating that the level of discomfort may be similar.

Lightly sedate patient to facilitate bandage changes with all types of bandaging, especially if wound lavage is going to be done before rebandaging.

Examination/Assessment

- Estimate the relative amount of exudate expected from the wound. In general, the amount of exudate decreases as healing progresses.
- Determine the stage of wound healing as well as whether debridement, development of granulation tissue, or epithelialization is required.
- On the one hand, if the wound is lightly to moderately contaminated or if substantial granulation or epithelialization has already begun, moist wound management will expedite the proliferative phase of wound healing. On the other hand, if the wound is extensively exudative or heavily contaminated with debris or foreign matter, a more aggressive debriding and absorbent technique, such as wet-to-dry bandaging, may be indicated.

Application

Correct Application of Wet-to-Dry Gauze Bandaging

1. Prepare the wound for bandaging according to good wound management principles, including a wide clip and thorough surgical preparation of the skin surrounding the wound.
2. Follow surgical or other means of prebandaging debridement with thorough lavage using sterile, isotonic, isothermic lavage delivered at 7 to 9 psi (35-ml syringe with an 18-gauge needle).
3. Gently dry the wound around the skin, and soak sterile, open-mesh, 4 × 4 gauze sponges in a 1:40 dilution of 2% chlorhexidine in sterile saline. Apply directly to the

wound. Next, apply a secondary absorbent layer consisting of a thick layer of bulky roll gauze. This may be supplemented with sterile laparotomy sponges or sterile surgical towels for highly exudative wounds, plus extra padding as needed. Avoid roll cotton and cotton cast padding, as both may leave cotton lint in the wound if they come in contact with the wound surface. The final (tertiary) layer provides mild compression and protection from the external environment, yet must be breathable, and may consist of coadhesive wrap or medical tape.

4. The bandage is generally changed at 24-hour intervals, although the rate of evaporation as determined by the amount of wound exudate, thickness of the bandage, and relative humidity determine the ideal change interval, which may be as often as two to three times daily or more. Change the bandage before the gauze contact layer dries completely.

Correct Use of Moist Wound-Healing Products

- Base selection of specific dressing on level of exudate and needs of the wound. The proper choice of dressing changes as wound healing progresses.
- General indications and properties of dressings used in moist wound healing are as follows:

Calcium alginate:

- Indications: moderate to high exudate, need for debridement or granulation
- Felt-like sheet or rope turns to hydrophilic gel during interaction with wound fluid
- Hemostatic properties: removal before fully gelled (2 to 3 days) may damage granulation tissue

Polyurethane foam:

- Indications: moderate to high exudate, need for granulation tissue and epithelialization
- Exudate is wicked into foam
- Premoisten foam to add moisture to dry wound. Change every 3 to 7 days; up to twice daily on highly exudative wounds

Hydrocolloid:

- Indications: low to moderate exudate, need for granulation or epithelialization
- Sheet, paste, granular, and powdered forms; turns to a gel during interaction with wound fluid



Moist wound management using a polyurethane foam/silver alginate pad in a dog

- Change every 2 to 7 days
- Contraindicated in infected wounds; adherence to skin around the wound can interfere with wound contraction

Hydrogel:

- Indications: low to no exudate or need for debridement or granulation
- Sheet turns to gel in wound; also available as amorphous gel
- Can donate moisture to desiccated wounds
- Change every 3 to 7 days
- If wound is infected, use amorphous gel if it can be changed daily; sheet is not recommended

Polyurethane film:

- Indications: minimal to no exudate, need for epithelialization
- Sheet, jell, powder, and rope forms available
- Adhesive perimeter
- May use as a bacteria- and waterproof cover over other dressings
- Not indicated in infected wounds
- Cut the dressing to fit the wound bed. For deep cavities or irregular surfaces, gel, powder, or rope dressings may be used to fill the defect.
- Moisture-retentive dressings should be changed before they dry out.
- The above dressings (with the exceptions of hydrocolloid, hydrogel sheet, and polyurethane film) may be used in infected wounds but must be changed daily.

excoriation, and strikethrough to the bandage surface can occur.

- During the latter part of the inflammatory phase (decreasing wound exudate), if the interval between bandage changes is too long, excessive wound drying at the surface can result. This tends to result in greater removal of proliferating granulation tissue and epithelium, which delays healing and may cause excessive bleeding from the wound surface during bandage removal.

Moist Wound Healing

Excessive moisture retention can lead to maceration (overhydration) and excoriation (chemical damage to skin from components of wound fluid) of the skin around the wound, compromising its barrier function. Avoid maceration and excoriation by selecting a dressing with absorbency appropriate for the amount of exudate produced by the wound and by placing the dressing so that it does not overlap onto peri-wound skin. Misinterpretations during moist wound healing are as follows:

- Dressings that turn to gel can have an odor and yellowish color that may be misinterpreted as infection. Assess patient for other signs of infection (eg, edema, hyperemia, heat, pain) before making this diagnosis.
- New epithelium may look white instead of pink and may be misinterpreted as maceration. The white color is normal in a moist wound environment, and the epithelium should become pink in a few days.

Monitoring & Follow-up

Reexamining the wound at appropriate intervals for the stage of healing is critical for

monitoring healing and for deciding which wound healing treatment should be applied next. **Management for optimal healing often requires a change in wound management technique as the wound changes and therapeutic goals change from decontamination to promotion of granulation and epithelialization.**

Even after an open wound is completely epithelialized, the new tissue remains more fragile and susceptible to trauma than the normal surrounding skin. Follow-up care for these wounds may include use of an Elizabethan or BiteNot collar (BiteNot Products, www.bitenot.com), or protective bandaging, particularly on the limbs for dogs, such as hunting dogs, that may incur inadvertent scrapes and cuts. Another reason for continued bandaging after completion of epithelialization is that continued nerve ingrowth may result in paresthesias with subsequent self-trauma from licking. A little extra investment in bandaging may save a lot of time and money by preventing a chronic ulcerative wound from developing.

Relative Cost

The relative cost of moist wound management compared with wet-to-dry techniques in veterinary medicine is difficult to compare. Moist wound management may involve fewer bandage changes, thus less cost to the client. On the other hand, at times a more aggressive debridement by wet-to-dry bandaging may lead to earlier complete debridement allowing an earlier surgical closure, which may often result in lower overall expense than continued management for second-intention healing. Another consideration for the practitioner is the cost of inventory and product shelf life versus expected turnover; moist wound management products are significantly more expensive than simple wet-to-dry bandaging materials. This is not to say that moist wound products cannot be cost-effective for both the client and the veterinary practice, but rather that inventory should be carefully managed. Veterinarians are encouraged to become familiar with one or two products from each category of moist wound healing dressings and consult with manufacturers' representatives for product details. ■

See Aids & Resources, back page, for references, contacts, and appendices.

Complications

Wet-to-Dry Bandaging

- During the early part of the inflammatory phase when the wound is highly exudative, if the interval between bandage changes is too long, bandage saturation with maceration,