PRINCIPLES OF MOIST WOUND HEALING
(OR WHY WET-TO-DRY BANDAGES MAY BE ALL WET)

Bonnie Grambow Campbell, DVM, PhD, Dipl. ACVS
College of Veterinary Medicine
Washington State University
Pullman, WA

Moist wound healing is the process of creating a wound environment that optimizes the body’s inherent wound healing abilities. White blood cells, fibroblasts, endothelial cells, epithelial cells, growth factors, proteases, and extracellular matrix all work together to repair a wound, and all function maximally when in a moist environment. Use of an occlusive moisture retentive dressing (MRD) ensures that wound fluid remains in contact with the wound bed, providing the proper mixture of proteases, protease inhibitors, growth factors, and cytokines at each stage of wound healing. It is important to recognize the value of wound fluid; “to remove exudate solely because it is present does not constitute good practice.”

WET-TO-DRY BANDAGING

Wet-to-dry bandages have been the standard for debriding contaminated or necrotic wounds. Saline-soaked gauze is used as the primary wound dressing. The gauze dries out, adheres to the wound bed, and adherent tissue is pulled away when the gauze is removed. While wet-to-dry bandages are effective in removing necrotic tissue, this method of debridement comes with many disadvantages. (1) Since both healthy and unhealthy tissues stick to the gauze, wet-to-dry bandages debride the wound non-selectively. Repeated removal of healthy tissue, such as new granulation tissue and epithelial cells, can delay healing. (2) A dry environment does not support the function of the cells or proteases involved in clean up and repair of the wound. (3) Bacteria penetrate moistened gauze much more readily than occlusive dressings, increasing the risk for infection. (4) Dry gauze dressings disperse more bacteria into the air than MRDs during a bandage change, contaminating the treatment area and increasing risk of cross-contamination between wounds. (5) Fibers from the adhered gauze may remain in the wound bed, acting as a nidus for inflammation or immune reaction. (6) Wet-to-dry bandages are painful to remove, often resulting in the need for sedation of the patient when the bandage is changed. (7) While gauze is cheaper than MRDs, human studies have consistently found higher costs for wet-to-dry methods because of the need for more frequent bandage changes, the more frequent need for sedation during each bandage change, and slower healing rates. For all of these reasons, wet-to-dry bandages are no longer considered to meet the standard of care in human medicine.

MOIST WOUND HEALING

Proper debridement is essential for progression of wound healing from the inflammatory to the repair stage. White blood cell viability and migration are enhanced in a moist environment. These cells are well equipped to perform autolytic debridement, specifically targeting necrotic tissue and leaving healthy tissue unharmed. Under an occlusive dressing, white blood cells stay in the wound rather than migrating up into the open weave of gauze. Contact between the wound fluid and the wound ensures that autolytic proteases have access to necrotic tissue, and the warm moist environment provided by a MRD increases proteolytic activity. Rapid autolytic debridement decreases the amount of necrotic tissue formed, preventing deepening of the wound and decreasing the risk of bacterial infection. Autolytic debridement can be especially useful in compromised patients that are not suitable candidates for anesthesia and surgical debridement.

Moist wound healing also stimulates the repair phase of healing. Proliferation and activities of fibroblasts, endothelial cells, and epithelial cells are all enhanced, accelerating the formation of granulation tissue, wound contraction, and restoration of the normal barrier function of the skin.

The main source of clinician reluctance to employ moist wound healing techniques is the concern for infection. It is important to realize that regardless of management technique, all wounds are colonized by bacteria. However, colonization does not equal infection, and most colonized wounds heal uneventfully. Bacterial viability is supported by a moist wound environment, but so is the viability and function of the immune system, which is able to function optimally when the wound is kept moist. Scientific evidence strongly indicates that the incidence of infection is lower in wounds kept moist by an occlusive dressing. For example, a review of 69 clinical and research studies in people found the overall infection rate in wounds treated with occlusive dressings was 2.6%, significantly lower than the 7.1% found in wounds treated with conventional dressings (which included gauze and non-adherent materials). Several mechanisms are proposed to explain the anti-infection effects of the moist wound environment. First, occlusive dressings provide an excellent barrier against entry of exogenous bacteria into the wound. Second, moisture prevents tissue desiccation and necrosis, which serve as a culture medium for bacteria. Third, low oxygen tension in wounds covered by occlusive dressings lowers the pH to levels that significantly decrease growth of many bacteria in vitro. Lower wound pH also stimulates angiogenesis and fibroplasia, accelerating the healing process. Fourth, because MRD increase angiogenesis and thus blood supply to the wound, and because wound fluid is kept in contact with the wound bed, the concentration of systemically administered antibiotic levels in the wound may be increased. Fifth, and perhaps most importantly, the warm, moist wound environment under a MRD increases viability and activity of white blood cells and their enzymes, and keeps them in the wound.
A positive aspect of MRD from the patient’s perspective is the significant reduction in wound pain. People report that MRDs are much more comfortable than a non-occlusive dressing; this is believed to be due to the soothing effect of wound fluid covering exposed nerve endings. MRDs are also flexible, and provide good protection for the wound. Bandage changes are much less painful when using an MRD because the dressing does not adhere to the wound surface. Since MRDs allow longer intervals between bandage changes and result in faster healing, the number of bandage changes is decreased. Pain relief is a very important component of the healing process. In veterinary patients, comfortable bandage changes can eliminate the need for sedation and decrease overall anxiety of the patient associated with wound care.

MRDs keep the wound bed at physiological temperatures, supporting the functions of the myriad of cells types involved in wound repair. Thermoregulation is accomplished by occlusion, which prevents the cooling process of evaporation, as well as by the longer interval between bandage changes allowed by MRDs.

The early wound environment lacks a normal blood supply, and thus is in a hypoxic state. However, atmospheric oxygen is not required for healing. Wound healing is enhanced under occlusive dressings, which are impermeable to oxygen. Low oxygen tension in the fresh wound serves as a chemoattractant to white blood cells, and lowers the pH in the wound, which deters bacterial growth and favors collagen synthesis by fibroblasts. Lactate production by white blood cells in the low oxygen environment stimulates angiogenesis (and secondarily, fibroblast migration), and thus the formation of a well-vascularized granulation bed to support epithelialization. Oxygen impermeable dressings are contraindicated in ischemic wounds, which do require atmospheric oxygen. However, maintenance of a moist environment is still important in ischemic wounds.

Additional benefits of maintaining a proper level of moisture at the wound bed include the prevention of wound drying and subsequent expansion of the zone of tissue necrosis, lower incidence of scarring, significantly less aerosolization of bacteria during bandage changes, and enhanced local drug delivery and absorption. MRDs are also waterproof, preventing ingress of urine or other fluids from the environment.

Selection of the primary contact layer used for moist wound healing is based on factors such as wound size, shape, and location, amount and type of exudate, need for debridement, percent coverage with granulation tissue +/- epithelial cells, and presence or absence of infection. The ideal dressing should maintain a moist environment, eliminate dead space, cause no harm to the wound or surrounding skin, provide thermal insulation, and act as a barrier to bacteria. A properly moist environment is achieved by taking into account the dressing’s moisture vapor transmission rate (MVTR), a measurement of a dressing’s ability to absorb moisture, allow a controlled evaporative loss through its backing, and maintain a moist wound environment supportive of healing. The MVTR is the most important feature of occlusive and semi-occlusive dressings. Low MVTR strongly correlates with positive wound healing outcome and lower incidence of infection.

It is important to choose the appropriate dressing for the exudate level of the wound. As a general rule, foams or alginates are selected when there is a moderate to high amount of exudate, hydrocolloids are used when the exudate level is low, and hydrogels are used to rehydrate dry wounds. Because of the large number of MRDs now available, it is recommended that clinicians become familiar with 1 or 2 products in each category; this should allow appropriate treatment of most common wounds. Typically, occlusive dressings are changed every 2–3 days, but can sometimes be left longer, especially later in the healing process. In order to avoid maceration of the periwound skin, the MRD can be cut to fit the shape and size of the wound bed, with minimal overlap onto the skin.

References

Additional references available from the author upon request.