ADVANCES IN SUPERFICIAL WOUND MANAGEMENT

CLINICOPATHOLOGIC CONFERENCE

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INTRODUCTION

Wounds are a common presentation in the veterinary clinician's practice. Advancements in both human and veterinary wound management have decreased healing time and improved patient outcomes. Wounds may present in a variety of forms and management is tailored to the type, depth, location, chronicity, and stage of healing of such wounds. In the ever-changing world of wound management, there are many new and advanced therapies available for management of acute and chronic wounds.

HISTORY AND PRESENTATION

Presentation for wounds is most often straightforward, however, history may be unknown. Often patients present with an acute injury of unknown trauma. History, when known, may include dog fight, hit by car, gunshot, or some other type of trauma. A patient may also present with an unknown history of trauma, making determining the cause difficult. Whatever the presentation, management of wounds involves the same principles of lavage, decontamination, and preservation of blood supply.

PATHOPHYSIOLOGY

Understanding the phases of wound healing is important when managing a wound and developing a therapeutic plan. The first phase, the inflammatory phase, involves recruitment of neutrophils and macrophages to the site as well as platelet aggregation and clot formation. The second phase, the proliferative phase, involves granulation tissue formation through the recruitment of fibroblasts and collagen secretion. Re-epithelization also occurs in this phase of wound healing. The third, and final phase of healing is remodeling. Granulation tissues forms into a mature scar. This phase can last weeks to months.

The inflammatory phase begins at the onset of the wound and lasts three to seven days after the initial injury. It initiates debridement by recruiting leukocytes to prevent infection and vasodilates vessels to improve perfusion. During this phase signs of inflammation such as heat, swelling, and redness are present at the wound site.

The proliferative phase begins three to five days after injury. It consists of the production of fibroblasts that form a collagen matrix acting as a scaffold for wound repair. Angiogenesis occurs at this time, and together with fibroplasia produces a granulation bed. The granulation bed is important for migration of epithelial cells and contraction of the wound as well as for resistance to infection. Myofibroblasts act to pull the wound edges together.

The remodeling phase leads to a decrease in vascularity and cellularity of the area and formation of a scar. The maximum strength of the newly formed tissue is 80% of the original tissue strength.[9] In this phase type III collagen is replaced by type I collagen. This is the longest of the phases and receives less focus in the therapies implemented in healing.

Factors affecting healing time in animals include presence of infection or bacteria, age of the animal, concurrent diseases, blood supply, presence of hypoalbuminemia, and motion of the area. In general, younger animals tend to heal faster as well as wounds in areas with a stable blood supply and low motion. Presence of hypoalbuminemia hinders wound healing and concurrent diseases such as immune mediated disease, endocrine diseases, neoplasia, and malnutrition delay healing.[9]

DIFFERENTIAL DIAGNOSES

Different types of wounds and trauma can occur, and although helpful in determining if additional diagnostics are needed, usually do not affect the basic protocol in wound management.

One exception is the case of clean versus contaminated wounds. Clean wounds occur post-surgically and are made through aseptic technique. These may be managed through primary closure. Clean contaminated wounds occur surgically when a break in aseptic technique occurs. Contaminated and infected wounds are most common in private practice and are often left to heal through second intention. Types of wounds include abrasions, degloving injuries, puncture wounds, and lacerations.

DIAGNOSTIC APPROACH/CONSIDERATIONS

Consideration should be given to other potential injuries, especially in history of unknown trauma or hit by car. In cases of severe trauma such as hit by car or gunshot wounds, the patient should first be stabilized. Radiographs may be indicated in extremities with wounds of unknown origins to determine if any fractures occurred concurrently. Inserting a sterile probe into the wound can help determine depth and if the wound involves a tract. In chronic draining tracts, a fistulogram may also be performed to determine the extent of the tract. In the case of chronic, recurring wounds or abscesses, a CT may be indicated to look for evidence of a foreign body or another nidus of infection. Consideration must be given to fungal causes as well as bacterial causes and in any contaminated wound, culture and sensitivity is helpful in determining the best antibiotic choice. In older animals, neoplasia should always be a differential, and therefore, a complete blood count and chemistry may be useful in these cases.

TREATMENT AND MANAGEMENT OPTIONS

The first step in management of a wound case is lavage and debridement. Lavage can be done with sterile saline and an eighteen-gauge needle and syringe which provides the proper amount of pressure to remove foreign material without damaging healthy tissue and seeding bacteria deeper into the wound. Lavage works to decrease foreign contaminates and bacterial numbers that inhibit wound healing.[4] The most common complication in wound healing is infection. Infection significantly increases the wound healing time and has a negative impact on patient outcome. Debridement can be performed in a variety of ways including mechanical, surgical, enzymatic, or hydrodynamic. Debridement encourages onset of the proliferative phase of wound healing and is most often mechanical or surgical. Surgical debridement should be avoided in distal limb wounds to preserve as much healthy tissue as possible. In these cases, an adhesive dressing may be applied to debride necrotic debris and foreign material.[4]

Often an antiseptic scrub is utilized in initial lavage and debridement of contaminated wounds. Most commonly, chlorhexidine is used for its residual activity, usefulness in organic debris, and broad spectrum of antimicrobial activity. It is important to use a 0.05% solution to avoid damage to healthy tissue. Povidone iodine is another common antiseptic. However, it is not effective in organic debris, can be toxic to cells, and can prevent neutrophil migration.[4]

Topical antimicrobials may be useful to prevent infection until a granulation bed forms. The most common topical antimicrobials include bacitracin-polymyxin and B-neomycin, beta-lactam ointments, and silver sulfadiazine. These may be helpful in superficial wounds; however, deeper wounds often require systemic antibiotics. The use of systemic antibiotics should be based on culture and sensitivity as wounds are often contaminated with multiple species of bacteria.

In the past, dry wound environments were thought to accelerate healing. Most recent literature suggests the opposite. Moist wound healing prevents tissue and cell dehydration and death, stimulates angiogenesis and epithelization, increases breakdown of necrotic tissue and prevents pain at the wound site.[2] Wound dressings may play a role in the interaction between growth factors that recruit leukocytes and promote epithelization, angiogenesis and cell proliferation. Moist dressings keep cells viable and able to release growth factors and modulate proliferation. Another benefit of moist healing is decreased pain by keeping nerve endings from drying out. Overall healing is three to four days faster with moist healing versus dry healing.[2]

The use of adherent dressings is beneficial in the initial stage of inflammation and the process of debridement. Although wet to dry bandages have recently lost favor with some clinicians, their use in the initial debridement of a wound can be helpful, especially on distal limb wounds or wounds that are heavily contaminated. A laparotomy pad or gauze soaked in sterile saline and applied directly to the wound, wrapped, and allowed to dry over a 12-24-hour period can help remove necrotic and foreign debris. Adherent dressings can also be helpful with exudative wounds. After initial debridement, adherent dressings are not recommended because they disrupt healthy granulation tissue. At this point, moist dressings can be applied.

Several options exist for moist dressings in wound healing. In the transition from the inflammatory phase of wound healing to the reparative phase, semi-occlusive dressings such as calcium alginate can be used.[4] Calcium alginate contains salts of alginic acid extracted from specific types of seaweed. The dressing often comes in a pad and absorbs wound exudate creating a gel that promotes granulation tissue formation and epithelization. Once granulation tissue begins to form, the use of occlusive dressings is recommended. Occlusive dressings should only be used when exudation is minimal, once initial debridement has been performed, and when the wound enters the reparative phase. These dressings promote epithelization, protect new epithelial tissue, reduce fluid loss, and stimulate collagen synthesis.[4]

Types of occlusive dressings include polyurethane films, hydrocolloid dressings, hydrogels, hydrophilic dressings, and foam dressings. Polyurethane films are useful in more superficial wounds only penetrating part of the dermis. They form a protective barrier from bacteria and trap moisture inside the wound. They are typically used to cover a wound that has already had a hydrogel or hydrocolloid applied.[4] Hydrocolloids are made up of starches and accelerate epithelization and protect the wound from outside contaminants. Hydrogels increase collagenase activity and promote moist healing through their hydrophilic particles.[2] They come in mesh or fibers for more superficial wounds and pastes for application to deeper wounds. Hydrophilic dressings are one of the few occlusive dressings helpful in exudative wounds. These typically come in the form of flakes, powders, and pastes which absorb exudate and pull fluid from inside the wound out to promote a moist environment without exudates. The beads in hydrophilic dressings may also activate chemotactic factors attracting leukocytes to the area.[2] Foam dressings are indicated for cavitary wounds to fill defects and provide comfort. They are most helpful in wounds with moderate to minimal exudate. They contain a polyurethane backing that does not adhere to the tissue.

Other considerations for wound management and therapy include the use of natural agents such as honey. Honey has multiple properties beneficial in wound healing, especially in chronic wound cases. It contains a glucose oxidase that when broken down forms hydrogen peroxide which is thought to give honey its antimicrobial properties. One study compared growth of bacteria in wounds treated with honey versus sugar. Those treated with honey had a 32% decrease in bacteria within one week, while those treated with sugar had a 13% decrease, indicating honey may be superior to sugar in its use as an antimicrobial.[7] A second study in cutaneous wound healing in rabbits sited higher polymorphonuclear cell counts in controlled rabbits versus those treated with honey for their wounds suggesting the antimicrobial effect.[8] It is also thought that the presence of inhibin, low pH, and the osmotic effect of honey may also contribute to the positive outcome. The study found that wounds treated with honey versus those not treated were less edematous, healed with less scarring, and had better wound contraction and epithelization. It is believed that the high content of certain amino acids in honey contributes to collagen formation and that the vitamins and nutrients in honey provide energy for cell proliferation.[5]

One of the most recent therapies being implemented in chronic wound healing is laser therapy. Laser therapy is believed to reduce pain, reduce inflammation, stimulate an immune response and speed wound healing. The mechanism is thought to be through absorption of infrared light by cytochrome c oxidase which improves electron transport and production of ATP, thereby increasing cellular metabolism and respiration.[3] Several studies have demonstrated that low level laser therapy decreases healing time and promotes cell proliferation. These studies found that the energy in joules was important in the effects the laser had on wound healing. The maximal healing potential occurred at 1.1 J/cm^2 with twice weekly treatments and was inhibited at elevated levels of radiation of 10 J/cm^2.[6] When using the low-level laser therapy, there was an increase in phagocytosis by leukocytes, growth of fur, and healing of mechanically induced wounds compared to control on the same animals.[3] After one week of therapy, the treated wounds were half the size of control wounds. The laser therapy did, however, also increase the number of atypical cells leading to the concern of possible induction of neoplasia in animals. Further long-term studies may be indicated on laser therapy use and outcomes.

EXPECTED OUTCOME AND PROGNOSIS

With early aggressive intervention and management, wounds have a better prognosis and outcome. Options for wound closure in uncomplicated cases include closure of the wound once a healthy wound bed is established or allowing healing through contraction and epithelialization (second intention healing). Wounds with severe damage to the blood supply and ischemia have a poor prognosis and, depending on location, may require amputation, skin grafts, and other methods of closure and healing. With the use of moisture retentive dressing, wounds heal an expected 3-4 days faster.[2] Use of the newest treatment options available result in less scar formation and better organization of wound healing than being left to heal by second intention alone. Without early aggressive intervention, wounds have an increased risk of infection, prolonged healing time, and increased complication rate. Animals may even develop secondary bacteremia and septicemia.

OTHER PERTINENT INFORMATION

The management of large and severe wounds may require more advanced methods such as skin grafting and vacuum assisted closure. This paper focuses on the management of open, contaminated wounds and not on secondary closure of wounds and the many methods of tension relieving sutures, drain placements, and bandaging. These are important and dense topics beyond the scope of this paper.

CONCLUSION

The use of moisture retentive dressing and development of more advanced treatments of wounds has led to a better outcome and prognosis with wound patients. Understanding the type of wound and phase of healing it is in will aid the clinician in choosing the proper therapy and wound dressing needed. Although diagnostics are usually minimal, a culture and sensitivity of the wound is always indicated to choose the best antibiotic. Superficial wounds may be easily managed with topical antibiotics instead of systemic antibiotics, while deeper and more chronic wounds require systemic antibiotics and additional management often including use of wound dressings and bandages. New developments in wound care such as the use of moisture retentive dressings, honey, and laser therapy all aid in maximizing the chances for a good clinical outcome for patients presenting with chronic wounds.

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