What You Should and Should Not Put In or On a Wound

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There are many different dressings and potions marketed for treating equine wounds. Not all of them have evidence of safety or efficacy. It is prudent to understand what effect the dressing will have on the wound before using it. Author’s address: Colorado State University, Fort Collins, CO 80523; e-mail: dean.hendrickson@colostate.edu. © 2015 AAEP.

1. Introduction

The main concept in wound cleaning is to remove the necrotic tissue and other debris from the wound, while also reducing the bacterial load. The reduction in necrotic debris and bacteria will help the wound to heal more effectively, both functionally and cosmetically. Consequently, it is important to choose a technique that does not cause more necrosis and subsequent bacterial growth. Every cleaning agent and technique will cause some trauma to the wound. It is therefore important to weigh the cost to benefit of the technique prior to starting. In essence, the benefit of a clean wound must be weighed against the trauma that the agent will cause.

Cleaning agents will generally cause some type of chemical trauma leading to cellular toxicity. The most biocompatible cleaning agent should always be chosen to limit the toxicity to the wound bed. Various cleaning agents will be discussed further in this section. Human chronic wound healing groups have a saying: you should not put something in a wound that you would not be willing to put in your eye. It is a great way to consider limiting the trauma associated with most of our wound-cleaning agents. I think this is especially true in the field of veterinary medicine where we are often entrenched in historical use of cleaning agents and techniques.

Cleaning techniques also have the potential to cause trauma to the wound bed. Most techniques will cause some type of mechanical trauma to the wound. This is especially true when mechanical forces such as scrubbing or high-pressure lavage are used. The trauma to the tissue left behind must be considered when choosing a cleaning technique. The hope is that the veterinarian will choose wisely when selecting wound-cleaning agents and techniques so that wounds will heal quickly and effectively.

2. Saline (Isotonic and Hypertonic)

Isotonic saline has been shown to be as effective as 1% povidone-iodine (PI) in reducing infection rates in the human emergency room.1 Although the isotonic nature is gentle to the wound bed and unlikely to cause necrosis of the surrounding tissue, isotonic saline is somewhat acidic and it may be better to use a polyionic replacement fluid. Hypertonic saline (20%) is very effective in reducing bacterial numbers in the wound. However, it can be traumatic to nor-
3. **PI**

PI has been used extensively in equine wound care. However, the bulk of research shows that PI is very limited in reducing bacterial numbers in the wound. In one study, isotonic saline reduced bacterial numbers better than PI, whereas in another study there was no difference between PI and isotonic saline in bacterial reduction. In a third study, PI was not an effective substitute for wound debridement. The general thought is that PI causes necrosis of the underlying tissue leading to more bacterial infection. Consequently, PI should only be used around the wound over intact skin, and never in the wound itself.

4. **Chlorhexidine**

Chlorhexidine has been used since 1946. It has shown a lot of promise in reducing the bioburden of bacteria in intact skin. However, there is limited evidence showing that it can effectively reduce bacterial numbers in wounds without causing further trauma to the wound bed. In a study evaluating the antimicrobial effect of chlorhexidine and saline for irrigating a contaminated open fracture, there was no benefit to using chlorhexidine. Similar to PI, the toxicity to the wound bed most likely leads to tissue necrosis.

5. **Hydrogen Peroxide**

Hydrogen peroxide (HP) is popular for its effervescent effects. However, HP has not been shown to have antibacterial effects. There may be some limited benefit with regard to wound debridement but probably not enough to warrant the use of HP.

6. **Acetic Acid**

Common distilled vinegar has been shown to be beneficial in reducing pseudomonas infections in human patients. It is thought that the low pH of the acetic acid creates an environment that cannot be tolerated by select bacteria. It is generally used as a 0.25 or 0.5% solution with a 15-minute/day soak or compress. The wound should be rinsed with saline after therapy with acetic acid.

7. **Surfactant-Based Cleansers**

Surfactant-based cleaners are generally isotonic and are considered minimally toxic and irritating to the wound bed. They generally contain some type of surfactant such as polysorbate-20 or pluronic F-68. In 2005 Wilson et al. showed the surfactant-based cleansers were the least toxic of all wound-cleaning agents studied. The most toxic formulations were HP, modified Dakin’s solution (sodium hypochlorite and boric acid), and PI. The surfactant-based cleansers are very effective on minimally contaminated wounds and should be applied, allowed to sit for 1 to 2 minutes, rinsed off, and reapplied as necessary.

8. **Topical Antibiotic Silver**

Silver is a very effective antimicrobial agent. It has been used in many forms in veterinary medicine, most commonly as silver sulfadiazine cream (SSD). Newer formulated silver dressings also show great promise in reducing bacterial numbers in wounds. In a study comparing the use of SSD and nonadherent wound dressings, the SSD group had less exuberant granulation tissue. In a human burn study, the silver-impregnated dressings lead to significantly reduced length of hospital stay, analgesic use, wound infection, and inflammation compared with SSD.

9. **Topical Antibiotic Nitrofurazone**

Nitrofurazone was first approved for the use in animals in 1979 and has been applied to wounds in staggering volumes since that time. Yet, research from as early as 1979 has shown that nitrofurazone retards the healing rate by as much as 24%. Nitrofurazone should not be used in open wounds.

10. **Topical Antibiotic Triple Antibiotic Ointment**

Triple antibiotic ointment has been used since the 1950s. Research has shown the combination of polymixin B, bacitracin, and neomycin to have synergistic effects on bacterial reduction in wounds. A very interesting perspective on triple antibiotic ointment is that the bacterial susceptibility to it has basically remained unchanged since its discovery. Along with silver, it is one of the best topical agents available to use in a wound.

11. **Wound Dressings**

There are probably as many different wound dressings as there are wound cleaning agents. This lecture will focus on the agents the presenter has the most experience with.

Wound dressings should be chosen based upon the wound’s stage of healing. The author is not aware of any single dressing that provides benefits throughout all stages of the wound healing process. Consequently, the appropriate dressing will vary through the wound treatment. In general, the stages of wound healing can be divided into the following: debridement, wound moistening, granulation tissue development and wound contraction, and epithelialization. The wound should be kept moist in all of these stages as moist wounds will generally heal in half the time as wounds left exposed to air; as long as the appropriate dressing is chosen.

12. **Debridement dressings**

Debridement dressings are designed to remove bacteria and necrotic tissue from the wound. Debridement dressings should often be combined with some type of sharp debridement where the bulk of the
necrotic tissue is removed from the wound prior to dressing application.

Hypertonic Saline
Hypertonic saline dressings are woven gauze dressings impregnated with 20% saline. They provide an aggressive, nonselective debridement. They work by drawing the fluid out of bacteria and diseased cells, reducing their attachment to the wound bed, and then lifting them out of the wound when the dressings are changed. The author uses the most effective debridement dressings commercially available. You can make your own hypertonic saline by dissolving 200 g salt in 1 L boiling water. Lower concentrations of hypertonic saline do not seem to be as effective. This debridement dressing should be discontinued when the wound no longer seems infected.

Antimicrobial Dressings
One manufacturer’s antimicrobial dressing is a loosely woven gauze impregnated with polyhexamethylene biguanide (PHMB). PHMB is an antimicrobial that disrupts the cell walls of microorganisms. There is no developing resistance known to PHMB. The dressing was originally developed to apply over a wound to stop bacterial penetration (it is also used in baby wipes and contact lens cleaning solutions). It is now accepted that the dressing will kill bacteria when applied to “donate” moisture to the wound and improve the wound healing process. Gel dressings commonly contain water, glycerin, and a polymer. Some gel dressings incorporate a gauze that helps them maintain their normal shape. Either the amorphous or the formed dressings can be used to add moisture to a dry wound. As soon as the wound is moist, another dressing should be used.

14. Granulation Tissue Development and Wound Contraction Dressings
Calcium Alginate (Alginate)
In the past, exuberant granulation tissue has been the bane of the equine practitioner, and to think that you might choose a dressing specifically to encourage granulation tissue would have been frowned upon. However, one of the complications of equine wound healing is the lack of inflammatory response that is formed by the horse after wounding. Calcium alginate dressings will lead to an effective inflammatory process that will help wound healing proceed in an effective order. Another valuable benefit of the alginate dressings is that they contain a lot of calcium that is “donated” to the wound to encourage wound contraction. These dressings can also be placed directly on exposed bone that has been curetted to minimize bone sequestrum formation. As soon as granulation tissue fills the wound, these dressings should be discontinued.

15. Epithelialization Dressings
Semiocclusive foam dressings help to finish off the wound healing process. The foam dressings will increase the surface temperature of the wound by 1–2°F, which will preferentially select for epithelialization. They are a relatively closed-cell design so that the granulation tissue does not grow into the foam. The added benefit of the AMD foam is that it contains the same PHMB as described above in the debridement dressings to limit bacterial growth on the surface of the wound. It is not recommended to add any other agent to the wound during the epithelialization process.

In summary, there are many options for wound-cleaning agents and wound dressings that have either negative effects or unknown effects on the wounds. It is the veterinarian’s job to make sure to select a wound cleaning agent or a dressing that will encourage the most functional and cosmetic end result. If you are not sure what the dressing does, you should make sure to find out before using it. Many of these materials have quite detrimental effects on the wound.

Acknowledgments

Declaration of Ethics
The Author declares that he has adhered to the Principles of Veterinary Medical Ethics of the AVMA.

Conflict of Interest
The Author has written a book on equine wound care but has no conflict with the companies that manufacture the dressings and cleaning agents described in this article.
References and Footnotes


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