

Principles of Wound Care—Back to the Basics

Marcia Spear, DNP, ACNP-BC, CWS, CPSN

The body of evidence concerning wounds and wound care continues to increase. However, randomized control trials in wound care are lacking. The majority of supportive evidence that exists is based on multiple case studies and reliable clinician experiences. Regardless of the literature, basic principles are universally identifiable and include the following: reduce bioburden, reduce edema, and maintain a moist wound environment. This column briefly discusses each of these principles.

BIOBURDEN

Bacterial proliferation within a wound bed results in alterations of each phase of the wound healing process, thus prolonging healing and contributing to chronic wounds. In addition, the bacteria interfere with the host cells and the cascade of chemical reactions that should lead to wound closure. These foreign bacterial cells produce their own chemicals that are usually tissue destructive as well as stimulate host cells to produce more and more inflammatory mediators and affect the formation of granulation tissue (Sibbald, Ovington, Ayello, Goodman, & Elliott, 2014). In addition, hemostasis can be altered through the bacterial effects on platelets and complement (Janis & Harrison, 2014). Bacteria can cause platelet agglutination and may also result in thrombocytopenia (Robson, Stenberg, & Heggors, 1990).

The negative impact of bioburden, including biofilm, impacts wound healing. Biofilms are a way in which bacteria become resistance to antimicrobials. A biofilm is a complex structure of microorganisms contained in an extracellular matrix of proteins and polysaccharides that

adhere to a surface, creating a protected environment for the organisms (Spear, 2011b). Currently, the most effective treatment for combating biofilms in both acute and chronic wounds is debridement and the treatment of appropriate antimicrobials to prevent reformation.

Identifying high levels of bioburden can be a challenge. The classic signs and symptoms of infection in an acute wound include erythema, localized pain and heat, cellulitis, and edema and are much easier to recognize. However, chronic wounds present more of a challenge and may have a bacterial load that impedes wound healing before the classic signs of wound infection are evident, (Spear, 2011a). In the presence of increasing exudate, delayed healing, discoloration of granulation tissue, friable granulation tissue, pocketing at the base of the wound, foul odor, increasing pain, and wound breakdown, high levels of bioburden should be considered and treated (Gardner, Frantz, & Bradley, 2001).

The treatment of bacteria bioburden requires combining antimicrobial agents with moisture balance and, when required, debridement. Topical agents often used are antibiotic ointments or creams. However, the use of these topical agents, instead of a dressing or debridement, has disadvantages including: potential for contact dermatitis, narrow antimicrobial spectrum, does not provide moisture balance, will not provide any debridement, including autolytic, and one mutation of bacteria may result in antimicrobial resistance (Sibbald et al., 2014). Surgical or enzymatic debridement should be utilized in the case of necrotic tissue to decrease bioburden. Other treatments include the following:

- Silver, combined with foams, alginates, contact layers, hydrogels, collagen have potential for anti-inflammatory action.
- Iodine, such as a cadexomer molecule for absorption and autolytic debridement, allows slow release of the antimicrobial.
- Chlorhexidine, polyhexamethylene biguanide, in a gauze or foam packing.
- Honey, combined with alginates or hydrogel, produces a slow release of peroxide as an antibacterial dressing.
- Methylene blue and genatin violet bound to a foam that is slowly released on the basis of the amount of exudate provides antimicrobial coverage.

Marcia Spear, DNP, ACNP-BC, CWS, CPSN, received her Doctor of Nursing Practice from Vanderbilt University School of Nursing. She is faculty at both the School of Medicine and the School of Nursing at Vanderbilt University. She has more than 20 years of experience in plastic surgery and wound care and is presently working as a nurse practitioner and a certified wound specialist for the Department of Plastic Surgery at Vanderbilt University Medical Center.

The author reports no conflicts of interest.

Address correspondence to Marcia Spear, DNP, ACNP-BC, CWS, CPSN, Department of Plastic Surgery, Vanderbilt University Medical Center, S-2221 Medical Center North, Nashville, TN 37232 (e-mail: marcia.spear@vanderbilt.edu).

DOI: 10.1097/PSN.0000000000000057

- Debridement: surgical, mechanical, sharp, or enzymatic as appropriate.

The treatment of bioburden is different from treating a documented culture positive infection, defined as bacterial levels of 10^5 colony-forming units per gram of tissue, and more aggressive therapies may be needed.

EDEMA

In normal tissue, each cell is close to a capillary to receive oxygen and nutrients by diffusion. An increase in extracellular water increases diffusion distances interfering with cell function, causing cell death, a toxic wound environment, and impaired wound bed repair or regeneration. An increase in interstitial protein deposition can act as a diffusion barrier for growth factors and nutrients. Edema is not a disease but a symptom of a disease. Less severe forms of edema can be a result of lifestyle and overall general health such as staying in one position for too long, increased sodium intake, hormonal changes, and pregnancy. Edema can also occur as a side effect of medications, including vasodilators, calcium channel blockers, estrogen-based medications, nonsteroidal anti-inflammatory drugs, and certain diabetes medications. Edema can also be a sign of severe underlying medical conditions, including congestive heart failure, cirrhosis, kidney disease, chronic venous insufficiency, chronic lung disease, or a damaged lymphatic system.

In addition to severe swelling, the overlying skin will have a stretched, shiny appearance. In cases of pitting edema, the skin over the affected area will retain a depressed or dimpled appearance after being depressed for only a few seconds. In individuals with peripheral edema, such as in venous hypertension, the swelling is often worse after extended periods of sitting or standing. Anasarca, or general edema, will present with swelling over the entire body and results from heart, renal, or liver failure. In addition, any condition that affects the permeability of vascular membranes such as inflammation or tissue trauma can also cause fluid to leak out of the intravascular compartment. Edema can also be related to impairment of the lymphatic system in carrying away interstitial fluid such as in lymphedema resulting in chronic edema of the tissues.

Typically, treating edema begins with diagnosing and treating the underlying cause. Diuretics may be prescribed in combination with a low-sodium diet to increase water output from the kidneys as in the case of congestive heart. Oftentimes, simple bedrest with extremities elevated can begin to alleviate some of the edema. Peripheral edema can also be treated with compression therapy. Current forms of compression are hosiery or stockings, bandages, boot systems, legging orthoses, and pneumatic pumps (Davis & Gray 2005; Hunter, Langemo, Hanson,

Anderson, & Thompson, 2005). A circulatory assessment, including ankle brachial index or toe brachial index, must be performed before initiating compression therapy. Elastic compression consists of bandages, stockings, and socks. Multilayer wraps or bandages such as 2, 3, or 4 layers produce as much as 40 mmHg pressure at the ankle and 17 mmHg pressure at the knee. Choice of compression therapy utilized most often is patient specific.

Inelastic compression therapy produces rigid compression and has low resting pressures with inactivity and high pressures with activity as the calf muscle pump contracts and provides a working pressure. Types of inelastic compression include leggings, the Unna boot, and intermittent pneumatic compression. The Unna boot goes on wet and becomes rigid as it dries, promoting the calf muscle pump with activity (Hunter et al., 2005). Pneumatic compression, in addition to compression therapy, has been found to be effective in delivering pressures as high as 180 mmHg intermittently for short periods (Trent, Falabella, Eaglstein, & Kirsner 2005). Treating edema in the presence of wounds is essential and this includes treating the underlying cause.

MOIST WOUND HEALING

Wound assessment, including location, size (L × W × D), and characteristics of the wound base, wound edges, exudate, the surrounding skin, and odor, must be carefully performed and documented. Moisture balance is important to consider. The classic study of Winter (1962) on pig skin resulted in a paradigm shift that wounds heal better in a moist environment. Hinman and Maibach (1963) demonstrated the benefits of moisture balance in human subjects. After Winter's discovery, there was an increase in focus on occlusive and semioclusive dressings and intelligent dressings were developed that adapted their permeability in response to exudate levels to maintain a constant moisture balance, now considered the gold standard in wound care.

Moisture balance today in modern wound care is essential. Allowing the wound to dry out decreases fibroblast proliferation and inhibits epithelial cell migration (Winter, 1962). Moisture balance is accomplished with dressings that create a moist wound surface (Sibbald et al., 2014). An ideal dressing removes excessive exudate and debris, maintains moisture at the wound/dressing interface, and permits evaporation of fluid. If there is too much moisture, dressings that wick moisture away and lock it in the dressing to maintain moisture balance should be utilized. Such dressings include foams, alginates, and hydrofibers. To maintain moisture balance, more frequent dressing changes may be necessary. In contrast with wounds that are too dry, using dressings that donate moisture such as hydrogels should be considered and often necessitate less frequent dressing changes. Ongoing assessment must be

performed and dressing changes as necessary that balance moisture for moist wound healing.

SUMMARY

The majority of supportive evidence that exists in wound care is based on multiple case studies and reliable clinician expertise, knowledge, and experience with a lack of randomized control trials. The 3 principles of wound care discussed in this article should be incorporated in any plan of care regardless of the etiology of the wound(s). They may be initiated even by the most novice wound care provider.

REFERENCES

- Davis, J., & Gray, M. (2005). If the Unna's boot bandage as effective as four layer wrap for a managing venous leg ulcer. *Journal of Wound Ostomy and Continence Nursing*, 32(3), 152–156.
- Gardner, A., Frantz, R., & Bradley, N. (2001). The validity of the clinical signs and symptoms used to identify chronic wound infection. *Wound Repair and Regeneration*, 9(3), 178–186.
- Hinman, C., & Maibach, H. (1963). Effect of air exposure and occlusion experimental human skin wounds. *Nature*, 200, 277–378.
- Hunter, S., Langemo, D., Hanson, D., Anderson, J., & Thompson, P. (2005). Compression therapy for venous ulcers. *Advances in Skin & Wound Care*, 18(8), 404–408.
- Janis, J., & Harrison, B. (2014). Wound healing: Part I. Basic science. *Plastic and Reconstructive Surgery*, 133(2), 199e–207e.
- Robson, M., Stenberg, B., & Heggers, J. (1990). Wound healing alterations caused by infection. *Clinics of Plastic Surgery*, 17, 485–492.
- Sibbald, R. G., Ovington, L., Ayello, E., Goodman, L., & Elliott, J. (2014). Wound bed preparation 2014 update: Management of critical colonization with gentian violet and methylene blue absorbent antibacterial dressing and elevated levels of matrix metalloproteases with an ovine collagen extracellular matrix dressing. *Advances in Skin and Wound Care*, 27(Suppl. 1), 1–6.
- Spear, M. (2011a). Infected? Or not? *Plastic Surgical Nursing*, 31(3), 174–175.
- Spear, M. (2011b). The biofilm challenge: Breaking down the walls. *Plastic Surgical Nursing*, 31(3), 117–120.
- Trent, J., Falabella, A., Eaglstein, W., & Kirsner, R. (2005). Venous ulcers: Pathophysiology and treatment options. *Ostomy Wound Management*, 51(5), 38–54.
- Winter, G. (1962). Formation of the scab and the rate of epithelisation of superficial wounds in the skin of young pigs. *Nature*, 193, 293–294.

For more than 29 additional continuing education articles related to plastic surgery, go to NursingCenter.com/CE.