What Interventionists Need to Know About Wound Care

Advanced wound care, dressing options, and the importance of a team-based approach for achieving lower extremity preservation.

BY DESMOND BELL, DPM, CWS

A number of years ago, I was invited to present at a meeting that was attended by a majority of interventionists. During a break, I was humbled by the words of a vascular surgeon who expressed his admiration for the work I do each day as a podiatrist specializing in wound care and lower extremity preservation. I reacted by telling him how much admiration I have for anyone who can open an occluded artery in a patient facing amputation. Restoring blood flow to a previously ischemic limb gives me a much more realistic chance for a favorable outcome in the treatment of wounds that are often found in my diabetic patients (Figure 1).

That being said, my friend and colleague, Yazan Khatib, MD, an interventional cardiologist, once said to me, "We do the plumbing, and you guys do the drywall."

"Toe and flow" is a term that was first coined in an article by Rogers and Andros et al in 2010.[1,2] Although this article has become highly referenced, the exclusion of interventionists in the team approach is of concern. The toe-and-flow model highlights the podiatrist and vascular surgeon as the key members of the limb preservation team, with recognition also given to other specialties, such as general surgery, plastic surgery, infectious disease, diabetology, orthopedic surgery, and pedorthics/prosthetics. On a positive note, it further validates the team approach and stresses the importance of interdisciplinary referrals. The point here is that this approach, while making each other's specialties look good, also gives many patients a new lease on life, whereas before, amputation was often the only option considered. Sadly, however, in the hectic-paced and somewhat-myopic world of the interventionist, actually seeing the net result of your efforts is infrequent at best. Viewing before-and-after angiograms can help to derive satisfaction, but seeing things from the perspective of the wound specialist can help to make the interventionist a true healer, as opposed to a technician. As wound specialists, we often hear words of wisdom, such as "See the whole patient, not the hole in the patient!" Let's venture beyond the walls of the cath lab and take a look at some issues that you, the interventionist, should know about wound care that may propel you beyond your present skill level.

WOUND CENTERS, SPECIALISTS, AND THE TEAM APPROACH TO LOWER EXTREMITY PRESERVATION

During my first few weeks of residency training at the Department of Veterans Affairs Medical Center in Philadelphia, I quickly realized the importance of my role as a podiatrist in the team approach to medicine. Wound care aside, I would make rounds with the physicians, who were mostly internists from the Medical College of Pennsylvania/Hahnemann and the University of Pennsylvania. As great as my attendings were at managing medical conditions, whenever a patient was afflicted with a lower extremity wound, they would inevitably seek my help. What struck me was that I was barely out of podiatry school, yet the best and brightest recognized the importance of the lower extremity specialist in managing wounds. Fast-forward to nearly 2 decades later, and wound care has become an industry that has its own subspecialties—lower limb preservation being one of them.

Figure 1. This patient presented with gangrenous toes (A), as well as wounds to the sole and heel of the left foot (B). By the day of surgery, the condition had deteriorated (C, D).

Although the present model of delivering wound care in wound centers is far from perfect—in my opinion, the biggest limitation is the lack of dedicated full-time wound specialists—many spared legs and saved lives are further testimony to the team approach. The advent of endovascular techniques and products has been responsible for expediting the team approach to wound care and limb preservation. The wound care market has seen exponential growth in the number of products designed to facilitate healing; however, the fact remains that without adequate perfusion to any wound, even the best product will be useless. Modalities such as hyperbaric oxygen are excellent adjunctive therapies, but unless the primary source of blood flow is via key arteries, the chances of healing a wound and preserving a leg are significantly diminished.

Conversely, what good are the talents of the interventionist and the breakthrough endovascular products if patients are not gaining optimal access to either? The key in creating an effective community- or hospital-based lower limb preservation team is in creating better understanding of the roles of each of the team members. There are wound care specialists who come from a variety of disciplines, including nurses and nurse practitioners, physical therapists, and podiatrists. Vascular and general surgeons often wear the hat of being wound specialists, especially if affiliated with a wound center. The interdisciplinary approach often finds the wound care specialist at the front line in recognizing the presence of significant peripheral arterial disease or critical limb ischemia. Knowing where to refer patients is often a big challenge and an obstacle to timely consultation with interventionists.

In short, if we think we can save a leg, we are going to refer the patient to you, the interventionist. We are

Figure 2. Patient at 18-month follow-up. Both limbs have been preserved.

grateful to have blood flow to help heal a wound. In return, we are happy to closely monitor patients in the postintervention phase of their care and refer back to you in the event that a patient's condition deteriorates.

WHAT IS ADVANCED WOUND CARE?

To put things in a historical perspective, methods to increase the healing rate of wounds have been present for thousands of years. Topical applications of silver, for example, date back to Hippocrates. Today's wound care market is resplendent with silver-impregnated dressings, among others, that are designed to reduce the bacterial burden that impedes wound healing.

What advanced wound healing is not, is wet-to-dry dressings. Wet-to-dry dressings are not considered the standard of care, and their persistent use in wound care is not evidence based. True wet-to-dry dressings are a nonselective method of wound debridement. They are not intended to maintain an optimal environment that promotes angiogenesis, perfusion, and autolytic debridement, as are advanced dressings. Wet-to-dry dressings, when properly used, allow gauze to adhere to the base of a wound. Upon drying, the dressing is supposed to be pulled off without first remoistening it with saline. This violent action removes any nonviable and viable tissue that it interfaces with. The reality of the situation is that the act of removal is often quite painful to the patient, and as a result, providers will often hydrate the dressing before removing, thus defeating the true purpose of the dressing.

Fortunately, research and design has resulted in literally hundreds of advanced dressings that promote moist wound healing that have the added benefit of being atraumatic to remove. There are a number of categories for such dressings, ranging from hydrogels, hydrocolloids, alginates, collagens, and foams, to name a few. Many wound care specialists routinely use biological dressings that include living cells and growth factors, as well as acellular scaffolds. Unfortunately, and possibly due to the explosion of advanced dressings on the market during the past 15 years, confusion may exist and result in some providers being overwhelmed with the choices and therefore reverting back to the outdated use of wet-to-dry dressings.

MOIST WOUND HEALING

The concept that best reflects the data and evidence to support its efficacy and safety is that of moist wound healing. So what exactly is moist wound healing, and why is this different from wet-to-dry dressings?

A maintained moist environment is accepted as the optimal condition to promote wound healing. Under moist conditions and at body temperature, angiogenesis can proceed. The creation of new vessels allows for enhanced oxygenation of tissue, as well as delivery of growth factors and nutrients that serve a role in wound repair and new collagen synthesis, in addition to the delivery of infection-fighting leukocytes.

A continually moist environment can be achieved through proper dressing selection, although which dressing to use is often a source of confusion for physicians. As a result, wet to dry becomes the preferred dressing of many, despite nothing in the literature to support its use to promote wound healing.

DRESSING SELECTION

Although the past 15 years have seen a significant increase in the number of wound care products, many of which are dressings, this aspect of wound healing has caused much confusion among providers. For the sake of simplicity, basic dressings can be placed into categories that include hydrogels, alginates, hydrocolloids, collagen-based dressings, and foams. All serve to maintain a moist, warm environment that is conducive to optimal wound healing.

Another class of dressings is biological dressings. These have their own specific categories and include living skin substitutes, amniotic placental membranes, autologous growth factors, bioengineered growth factors, scaffolds, enzymatic debriding agents, and biological debriding agents.

Hydrogels are water-based gels of varying viscosity that are applied directly to the wound. They are covered with a secondary dressing, often gauze, and typically changed once daily.

Alginate dressings are derived from seaweed and have the ability in most cases to absorb significant amounts of drainage and, in doing so, convert into a gelatinous type of substance that further maintains the moist environment. Alginates are used for superficial or deeper wounds and can serve as packing where appropriate. They are often

kept in place at the wound site for more than 1 day and are typically changed after 3 to 5 days.

Hydrocolloids are usually sheet-type dressings that are composed of colloid particles, which are hydrophilic polymers dispersed in water. Besides maintaining a moist environment, one of the real benefits of hydrocolloids has been seen in cases where autolytic wound debridement is an objective. They are often derived from natural sources, such as seaweed. Agar and gelatin are examples of hydrocolloids, but as a wound dressing, the most well-known example would be DuoDerm (ConvaTec, Skillman, NJ).

Collagens are a category of dressings; their primary purpose is to enhance epithelialization of a wound that is demonstrating signs typical of healing. A clean wound without infection and the presence of mostly granulation tissue would be an indication to use a collagen dressing. Collagen is contained in a variety of dressings, including liquids, powders, and in combination with alginates.

Foam dressings are used primarily for wounds with light-to-moderate exudate and provide comfort at the site while allowing for oxygen exchange. These are not occlusive dressings and therefore would not be used to promote autolytic debridement.

Biological Dressings

Biological dressings can be extremely valuable tools when used appropriately. Three such dressings, Apligraf (Organogenesis Inc., Canton, MA), Dermagraft (Shire Regenerative Medicine, Dublin, Ireland), and Regranex gel (Healthpoint Biotherapeutics, Fort Worth, TX), have all been shown to increase healing rates of certain wounds in randomized control trials. Apligraf has been approved by the US Food and Drug Administration for use in treating both venous leg and diabetic foot ulcers, whereas Dermagraft and Regranex have been approved to treat diabetic foot ulcers.

These dressings contain varying amounts and types of growth factors needed for wound healing. Autologous growth factors are obtained by drawing a patient's blood and centrifuging the sample to separate out platelets. The platelets are further processed to release growth factor and combined with a topical gel that is applied directly to the wound.

Other biological dressings, whether harvested from human sources or animal (porcine, bovine), typically provide a scaffold in covering the wound that allows for migration of cells across the wound. This category of dressing is often used to promote granulation tissue before proceeding to skin grafting or application of skin substitutes.

Debriding agents also fall under the heading of dressings. Enzymatic agents (collagenase derived from *Clostridium histolyticum*) are applied topically to assist in removal of necrotic tissue from ulcers, whereas biological debriding agents, also known as maggot therapy (larvae of *Lucilia sericata*, the green bottle fly), are selective in removing devitalized tissue from wounds. Both methods have been in clinical use for extensive periods of time and are widely accepted adjunctive therapies.

NEGATIVE-PRESSURE WOUND THERAPY

As with other modalities, negative pressure has an important role in the healing of a range of wounds, and it should only be used where adequate perfusion has been determined or re-established. Applying negative pressure to a wound with poor perfusion or an ischemic wound is not only futile but is potentially harmful. That being said, negative-pressure wound therapy in the right situation can assist healing by reducing harmful drainage and promoting granulation. It is also widely used after surgical intervention and in chronic wounds for wound bed preparation before and even after skin grafting or biological dressing application. The combined use of negative-pressure wound therapy along with other primary dressings has gained increased clinical acceptance in recent years.

CONCLUSION

Better understanding of the role of the interventionist has helped me infinitely in my medical decision making. Knowing when to refer to an interventionist has been key to the successful outcomes of many of my patients afflicted with chronic wounds (Figure 2). Respecting the work of the interventionist and knowing what to expect after a patient undergoes an endovascular procedure often guides the ensuing treatment.

Interventionists who have some understanding of wound care will likely contribute to both higher wound healing and lower extremity preservation rates, simply by having a greater appreciation for the considerations the wound specialist must employ. Knowing what can be salvaged from the perspective of both the interventionist and the wound specialist can also prevent frustration, which is shared by the patient, while ultimately increasing confidence and outcomes in the process. ■

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2. Rogers LC, Andros G, Caporusso J, et al. Toe and flow: essential components and structure of the amputation prevention team. J Am Podiatr Med Assoc. 2010;100:342–348.