NEW & EMERGING CONCEPTS IN WOUND CARE PRODUCTS

As science advances the approach to and outcomes for nonhealing chronic wounds, it’s incumbent upon clinicians to be knowledgeable of available resources.

Heather Hettrick, PhD, PT, CWS, CLT, CLWT

Wound care products and applications continue to evolve. This can be challenging for both the seasoned clinician as well as those new to the field of wound management. Keeping current with trends and scientific literature can also be a difficult task due to increased demands for productivity while having less access to resources and time. This article will provide an overview of some new and emerging products available for wound management. A comprehensive review is beyond the scope of this article; however, unique products and features will be discussed to provide insight into emerging options available to manage complex wounds. For the purposes of this review, we will focus on some of the new and emerging dressing and topical technologies such as microcurrent, exudate transfer, bacterial binding, protease modulation, amniotic membranes, cellular and tissue-based products (CTPs), and emerging interventions under development.

A BRIEF HISTORY ON DRESSINGS

Historically, the first wound treatments were described more than five millennia ago. Although the science behind some of the interventions was not thoroughly understood, practitioners of the time utilized various natural products to manage “diseased” wounds (infection), to cleanse wounds, and to prevent inflammation. Figs containing papain helped to debride wounds; wine, vinegar, and water were used to cleanse wounds; and dry powders containing metals (mercury, zinc, silver, and copper) were used to reduce and prevent inflammation. The Egyptians may have been the first to employ the principles of moist wound healing through linens soaked in grease, honey, oil, and lint.1 To today, we have evidence and science to support our wound interventions, yet we continue to use derivations of the treatments utilized thousands of years ago, such as plant-based products, metals, and honey. Overall, the woundologist must consider the five main goals of topical care: optimization of the wound environment, wound stabilization, activation of the wound environment to hasten healing, bioburden control, and quality-of-life improvement.

With more than 4,000 products available on the market and more becoming available, it is important to separate them into categories. General dressing categories are a great starting point, such as hydrocolloids, hydrogels, collagens, foams, etc. Increasingly, more products are combining characteristics of these general categories to create products with unique wound healing characteristics (ie, silver-impregnated alginites provide antimicrobial coverage while absorbing and managing exudate). Such combination dressings, however, still fall under the main dressing categories. They are categorized according to whichever product they primarily consist of. Antimicrobial dressings are a category in and of themselves, given the various components and ingredients used to provide either broad-spectrum coverage or targeted functionality.

A NEW APPROACH TO E-STIM

In 1982, Barker and colleagues concluded that human skin has a sodium-dependent battery that may drive epidermal healing.2 From this, Robinson in 1985 altered the orientation and galvanotaxis of epithelial and fibroblast cells using electrical fields.3 Vanable (1989) determined the highest electrical potential occurs in the first 0.5mm of skin bordering a wound and that there is negligible current in dry wounds.4 In 1991, Neher and Sakman received the noble prize for detecting subtle electrical currents in cell membranes throughout human body.5 Electrical stimulation (ES) has been a mainstay biophysical agent with strong evidence to support its use during clinical wound management. Traditional ES can be time-intensive to achieve desired results. Treatments can last more than an hour and are often recommended 3-5 times per week. Because of this, Vomaris Wound Care Inc. has created a new spin on ES through the creation of a bioelectric dressing. This single-layer dressing consists of a polyester fabric containing elemental zinc and silver microcells ranging between 1 mm and 2 mm in diameter.
The Procellera® dressing requires no external power source, as the microcells are activated in the presence of conductive fluid (either wound exudate or exogenously applied normal saline). Once activated, it generates an electrical potential of 0.6–0.7 V, resulting in a sustained micro-current similar to that of skin injury. This provides continuous broad-spectrum antimicrobial activity that’s effective against bacteria, fungus, yeast, mold, and is indicated for use in diabetic foot ulcers, abrasions and skin tears, full-thickness wounds, skin eruptions, burns, traumatic wounds, surgical sites, and venous leg ulcers. Procellera can be used in combination with hyperbaric oxygen, compression therapy, negative pressure wound therapy, and CTPs.

Many chronic wounds tend to be further complicated by moderate to copious amounts of exudate. It is well known that chronic wound fluid often contains senescent cells, matrix metalloproteinase, and other substances that can further delay or hinder wound closure. Some newer products on the market have been designed to specifically manage wound exudate through unique and specific methods. Such products either focus on the concept of exudate transfer whereas others target and bind bacteria.

### ADDITIONAL DRESSING INTERVENTIONS

SteadMed Medical LLC has created a hydroconductive wound dressing (Drawtex®) using a proprietary LevaFiber technology. A combination of two types of absorbent cross-action structures draws exudate away from wound surface and holds and transfers the exudate vertically and horizontally. Drawtex can absorb 500% of its own weight, keeping the wound base and periwound area free from excess moisture.

Another unique product has the ability to bind bacteria. Cutimed® Sorbact® dressings by BSN Medical (Charlotte, NC) employs DACC antimicrobial technology (diakyl-carbamoyl-chloride), which creates a hydrophobic interaction where the dressing fibers bind the microbes to the dressing, render them inactive, and remove them whole. DACC does not contain chemical, pharmacological, or antimicrobial agents; therefore, there is no concern for bacterial resistance or sensitivity.

Similarly, another product combines both exudate transfer and bacterial binding characteristics. Kendall™ AMD Antimicrobial Dressings (Mansfield, MA) contain polyhexamethylene biguanide (PHMB) that effectively wicks wound fluid while employing bactericidal effects. Through its bacteria-killing polymer, it attacks bacteria on and within the dressing to effectively manage various wound pathogens and resistant organisms.

The wound literature continues to uncover the mysteries of the wound bed at the macrocellular and microcellular level. One area that has gained significant attention centers on proteases. Proteases have various roles in wound healing, such as growth factor activation, remodeling of the extra cellular matrix, and controlling the migration and activation of fibroblasts. However, in some nonhealing chronic wounds, protease activity remains at an elevated level that impairs wound healing and can lead to chronic inflammation.

Smith & Nephew has recently introduced Cadesorb, which has been specifically designed to control the pH of its local environment. In addition to the benefits of pH control and protease modulation, this topical product promotes slough removal and absorbs wound exudate. This white, starch-based sterile ointment controls local wound pH and thereby modulates protease activity. Studies have shown that chronic wounds have a typical pH value of around 7–8. There is evidence to suggest that a slightly acidic environment may promote healing of open wounds. Ex vivo studies have shown that treating wound fluid with Cadesorb lowers this pH value to around 5, allowing protease activity levels to return to those of a healing wound. By controlling pH levels and modulating protease activity, in addition to managing slough and exudate, Cadesorb may help correct or restore the natural balance in chronic wounds to stimulate healing.

Emerging technologies hold promise for accelerated and targeted healing. Stem cells and gene therapy will be at the forefront of wound healing over the next decade. In addition, DNA-guided personalized medicine will enhance wound healing trajectory as it is specifically targeted to the wound bed. Wound care practitioners are on the cusp of having bedside diagnostics to determine the specifics of wound burden, methods to detect subdermal tissue changes, and personalized medicine directed at the wound for a particular patient. Today, we have various new regenerative biomaterials made from amniotic membrane as well as CTPs.

Amniotic membrane (AM) is a unique material that is composed of structural extracellular matrix (ECM) containing collagen types I, III, IV, V, and VII. Further, it contains specialized proteins, fibronectin, laminins, proteoglycans, and glycosaminoglycans — all essential components for successful wound closure. In addition, AM contains essential active healing growth factors such as epidermal growth factor, transforming growth factor beta, fibroblast growth factor, and platelet-derived growth factor. For wound management, two companies manufacture AM products for clinical use; Liventa Bioscience produces AmnioClear™ and MiMedx produces EpiFix®.

AmnioClear is derived from human allograft membrane and comes in two forms: a patch of amnion or the entire amniocchorionic membrane in particulate form to mix with patient blood, forming a liquid wound covering.

AmnioClear is processed by the musculoskeletal transplant foundation that disinfects and dehydrates the amnion and chorion. This does not undergo terminal sterilization. According to the manufacturer, it is indicated for inpatient burn inter-

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vention, chronic ulcers, and as a post-operative covering. It is a good alternative to synthetic films and bovine collagen. Its potential benefits include that it is immune privileged, non-immunogenic, and provides endogenous collagen matrix with growth factors and antimicrobial peptides. Amnio-Clear is easy to handle, can be cut to size/shape, and is conformable; it is hydrophilic, stays in place, and has the ability to be stored.

EpiFix is available as an allograft or in micronized form, which is a dry powder that can be mixed with saline to form an injectable. EpiFix is dehydrated and sterilized via the PURION® Process and can be stored at room temperature for up to five years. The allograft is available in four sizes and is composed of epithelial cells, basement membrane, and avascular connective tissue matrix. EpiFix is a biologically active matrix containing growth factors. The manufacturer states it is indicated for acute and chronic partial- and full-thickness ulcers. Additional potential benefits may include enhanced healing, reduction of inflammation, and scar tissue formation, and it contains growth factors essential for wound healing.

MORE ON CTPs

CTPs continue to evolve and make a significant positive impact on healing outcomes. CTPs can be classified as acellular or cellular. Acellular products do not contain cells and consist of a matrix that functions by binding to the host, allowing matrix-cell interactions. Porous in nature, the matrix allows host cells to infiltrate. Today, a matrix can contain virus vectors, or plasmids, which can transcribe and translate the in-built DNA, leading to secretion of specific growth factors.6-9 These growth factors carry out specific functions by stimulating host cells to enhance wound healing. In specific conditions, it is even possible to manufacture matrices containing plasmids that can release hormones. The matrix contains ECM-proteins such as collagen, hyaluronic acid, and fibronectin, thus ensuring biocompatibility. Examples of these products include: e-Matrix™ (Syneron Inc.), OASIS® (Smith & Nephew), Integra® (Integra Life-Sciences), Permacol® (Covidien), Matriderm®* (Dr. Suwelack Skin & Health Care AG), and EZDerm® (Brennen Medical).10 Please refer to individual manufacturer guidelines for use.

Cellular products, conversely, do contain living cells, most often fibroblasts and keratinocytes embedded in a collagen or polyglactin scaffold that forms an epidermal skin layer.7 Autologous cells are used in these products to minimize the risk of rejection. Autologous keratinocytes are derived from progenitor cells from dermal sheets in the outer root surrounding hair follicles,10 or from epithelial cells obtained via biopsy of the recipient’s skin. A permanent autologous epidermal skin graft, which functions as a reliable barrier and promotes the formation of granulation tissue, is applied. Examples of tissue-engineered epidermal substitutes are: Epicel® (Sanofi), Laserskin® (Fidia Advanced Biopolymers), Myskin® (Celltran Ltd.), and EpiDex™ (Modex Therapeutics).11

Two of the most widely studied and utilized include Apligraf (Organogenesis) and Dermagraft (Shire Regenerative Medicine). Apligraf is a living-cell-based, bilayered skin substitute derived from bovine type 1 collagen and human fibroblasts and keratinocytes derived from neonatal foreskins. It is approved by the US Food and Drug Administration (FDA) for use with standard therapeutic compression for the treatment of non-infected partial and full-thickness ulcers secondary to venous insufficiency of greater than one-month duration that have not adequately responded to conventional therapy.

Dermagraft is a cryopreserved human fibroblast-derived dermal substitute. The fibroblasts are obtained from neonatal foreskin. Dermagraft is FDA-approved for use in the treatment of full-thickness diabetic foot ulcers that are greater than six weeks in duration that extend through the dermis, but without muscle, tendon, joint capsule, or bone exposure. It should be used in combination with standard wound care protocols and in patients with adequate blood supply to the involved foot/extremity. The benefit of such products is their regenerative healing capabilities. These products stimulate, improve, and modulate wound healing by stimulating the patient’s own cells to regenerate tissue. In addition, they deliver cytokines and growth factors while maintaining a moist wound bed. For additional product information and guidelines for use, refer to the manufacturers.

CONCLUSION

As stated by many, wound management is an art as much as it is a science. As science continues to rapidly grow and provide unique and novel dressings, topicals, and devices for wound management, it is incumbent upon the wound care practitioner to apply the art and customization of these resources for patient-centered care. Dressing selection can be challenging and overwhelming given the number of options available. One must consider the components of wound bed preparation, the clinical presentation of wound and patient, the prognosis, and goals of care in addition to the realities and constraints of medicine today. Staying abreast of the literature, attending conferences, and seeking advice from known wound experts; following manufacturer recommendations; and justifying product utilization through outcomes are methods to help all providers succeed.

*These products are not available for use in the US as of Today’s Wound Clinic press time.

Heather Hettrick is associate professor in the department of physical therapy at Nova Southeastern University, Fort Lauderdale, FL.

References available online at www.todayswoundclinic.com