Wound Dressings: An Evolving Art and Science

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Ms Baranoski disclosed that she is/was a recipient of grant/research funding from Hollister; was a consultant/advisor to KCI, Diversified Clinical Services, Mölnlycke Healthcare, Hill-Rom, Hollister, and Wound Care Educators; is a consultant/advisor to Mölnlycke and Hollister; and is/was a member of the speakers’ bureau for Hill Rom and KCI. Dr Ayello disclosed that she is/was a consultant/advisor to Mölnlycke Healthcare, and is/was a member of the speakers’ bureau for Healthpoint Biotherapeutics. The authors’ spouses have disclosed that they have no financial relationships with, or financial interests in, any commercial companies pertaining to this educational activity.

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This continuing educational activity will expire for physicians on February 28, 2013.

Editor’s note: In keeping with this issue’s theme of celebrating the journal’s 25th anniversary, the continuing education activity provides an overview of how dressings have evolved over the past 25 years.

PURPOSE:
To enhance the learner’s competence with knowledge of the evolution of wound dressings and future research trends.

TARGET AUDIENCE:
This continuing education activity is intended for physicians and nurses with an interest in skin and wound care.

OBJECTIVES:
After participating in this educational activity, the participant should be better able to:
1. Analyze the evolution of wound care dressings and future wound care trends.
2. Apply knowledge of dressing progression to clinical care in present-day settings.

ABSTRACT
Keeping abreast of the numerous wound dressings available for patient care is an ambitious task. Being able to differentiate among the various treatment options, when and how to apply them, in what combinations, and when to change them has become a challenge for all healthcare practitioners.

KEYWORDS: wound dressings, wound care management, history of wound dressings

INTRODUCTION
During the past 25 years, clinicians have been exposed to a multitude of wound dressings. The moist wound care revolution that began in the late 1960s has continued into the 21st century. Clinical and scientific research conducted during the past 2½ decades has improved clinicians’ understanding of the wound healing process and the importance of providing the right environment for the wound healing process.
to heal. Today, healthcare providers must understand the physiology of moist wound healing, occlusion, biofilms, matrix metalloproteases, the continuum of infection, wound bed preparation, and healable and nonhealable wounds, to name a few, and they must still maintain an appreciation of what wound dressing will work best in a specific circumstance or environment.

For thousands of years, dressing material has been used to provide protection, absorption, and/or a base for healing. Wound care has evolved from magical incantations, lotions, potions, and ointments, to today’s market of modern wound therapy dressings. By reading this article, clinicians will be able to differentiate the types of wound dressings that evolved during the past quarter century.

**MOIST WOUND THERAPY**

Wound healing in the 21st century has certainly changed. During the past 25 years, the wound care profession has made more advances than it did during the previous 2000 years. The wound care revolution has occurred due in part to Dr Winter’s discovery (in the 1960s) of the importance of moist wound healing in experimental animals. Hinman and Maibach paralleled these findings of faster resurfacing in partial-thickness wounds in humans. These combined research efforts have laid the foundation for understanding the importance of moisture and moisture loss to wound healing. The concept of moist wound healing and moisture-balanced dressings for healable wounds is now commonly accepted by most clinicians throughout the world as best practice.

Clinicians now understand that wound healing must take place in a moist environment. Epithelial cells require moisture to migrate from the wound edges across the wound bed to reepithelialize or resurface the wound. This process is likened to “leap-frogging” of the cells. In a dry wound, these cells have to burrow down underneath the wound bed to find a moist area upon which to “march” or move forward.

The importance of moist wound healing based on wound physiology and characteristics required that new dressing materials be developed. Rather than the passive coverings used in the past, which evolved from “natural” coverings, such as feathers, lint, grease, milk, wine, mud, leaves, and other strange concoctions, industry has investigated and introduced newer dressing materials based on the understanding and biology of wound science. Today’s more newly conceived wound dressings are designed to actively stimulate cell proliferation and encourage epithelial cells to migrate. Moisture-balanced or moisture-retentive dressings also act as a barrier against bacteria and absorb excess wound fluid, creating favorable conditions for healing. Formerly, wound dressings were primarily used to protect the wound from secondary infection by forming a barrier against bacteria and absorbing wound fluid. The greatest advantage of contemporary dressings is the maintenance of moist wound conditions in contrast to the “classic gauze techniques” that lead to the formation of a dry, firmly adhering scab. Dressings now promote rapid healing, act as a barrier, decrease or eliminate pain, require fewer changes, provide autolytic debridement, and can be cost-effective, if used appropriately.

The first moist wound therapy dressing was a semiocclusive film (implies partial impermeability to gases). This dressing supported researchers’ theory that wounds resurface faster when covered with a plastic urethane material as compared with identical wounds that were left open to air. This jump-started the wound industry, and several other adhesive-coated polyurethane film dressings became available.

The 1980s saw the birth of hydrocolloids. Hydrocolloids are dressings that contain hydrophilic colloidal particles, such as carboxymethyl cellulose, gelatin, or pectin formulated in an adhesive mass/dressing and provide an occlusive (impermeability to gases) environment for the wound to heal. This conjured up concerns and questions, such as the following: Could an occlusive dressing really heal a wound? Was accumulation of pus/infection a concern? Was there a risk of a hematoma, seroma, or folliculitis, to name a few? Wound researchers began studying local atmospheric oxygen and its effect on healing. “The fact that an airtight dressing enhanced wound repair was somewhat of a shock since it had long been thought that ‘the wound must breathe.’”

Hydrogels were also introduced into the market in the 1980s. When the first commercialized wound hydrogel dressing became available, clinicians were excited to have a product that could put moisture back into a dry, desiccated wound. The concept of rehydration and promotion of healing created opportunity for researchers to delve into what really induces a wound to heal. This new water-matrix-based dressing seemed to facilitate a healing environment, was soothing to the wound, and, most important, did not adhere to the wound.

The commercialization of the wound care products greatly expanded in the 1980s. Industries interested in promoting dressings that could heal wounds faster and with less trauma to the patient began to flourish. Urethane foam products were launched as another option for clinicians to add to their tool kit of modern wound dressings. These products offered advantages over traditional gauze dressings, as they did not shed...
The concept of fluid management and controlling on the drawing board. The 1990s brought a new level of importance to understanding the functionality of wound dressings and their impact on the healing process. Wounds are dynamic entities with changing characteristics that should drive the selection of dressings over time. Multiple types of dressings may be required to manage a single wound over its healing trajectory. With the increase in the number and type of dressings available, the need for education about wound dressings also became more apparent. This meant that clinicians had to become more familiar with the products they used and not just assume that all product categories performed the same. Education on wound care products and appropriate management of wounds increased as a favored topic at conferences and seminars, addressing how to select the right dressing on the right wound at the right time.

The myriad of products available for wound care have enhanced the overall management of patients, but have also created confusion about selecting the appropriate product. Dressing algorithms, enablers, and other educational charts were created to help general clinicians, as well as wound care specialists, in their clinical decision making about which dressing to use when. Optimal wound interventions should be dependent on the basic principles of wound care, attentive wound assessment, and expected outcomes. A complete wound assessment should be the driving element in all treatment decisions.

THE 1990s
The 1990s saw a rapid growth in the development of dressing materials with similar protection, absorption, and wound management properties. New dressings emerged, and soft silicon dressings in numerous sizes became available. Antimicrobial agents were introduced into dressing materials, and silver dressings exploded in the marketplace. Collagen and matrix dressings saw an increased interest. Growth factor research continued, and negative-pressure wound therapy became a strong focus on managing heavily exuding wounds. Low-powered lasers and electrical stimulation were other therapies that were aimed specifically at stimulating local cells in the wound and promoting healing. Recommendation for the clinical use of hyperbaric oxygen therapy continues to be studied with promising results. The selection of available products expanded to include the first biological allograft or skin substitute. Skin substitutes consisted of dermal cells, epidermal cells, or both supported by a matrix (autologous, allogenic, or xenogenic). Allogenic skin substitutes are often referred to as bioengineered-tissue products. Researchers and studies conducted in the 1990s yielded new knowledge that the fluid contained in occlusive dressings has proteolytic enzymes and functional growth factors that facilitate an optimal and expedient healing process. Scientific examination of fluids from healing versus nonhealing wounds identified biochemical differences in the local environment of each. These quantitative and qualitative differences have led to new approaches in wound management and clarification of the differences between healing and nonhealing wounds.

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THE 21st CENTURY
Wound care and the management of our patients certainly improved during the 1980s and 1990s. As the year 2000 and the new millennium began, technology was still advancing in the field of wound care. Many current technologies were improving and expanding, and many new methods were still in the laboratory being developed and researched. Despite the benefits of newer modern dressing products and treatment options, wet-to-dry gauze unfortunately remains a popular dressing with healthcare providers, especially surgeons who have not been influenced by the development of modern wound dressings. Hopefully, the 21st century will educate and influence all clinicians on their treatment choices.

Much has been learned from the past regarding the benefits of moist wound healing, and much research remains to be done when it comes to truly understanding the essential elements of the wound environment. The center of attention in this century has been on evaluating the “other” parameters/chemicals contained in wound fluid and in the tissues of chronic wounds. A balance of these parameters will be just
as important in understanding wound healing as is its predecessor, moist wound healing.

A true understanding of how the level of bacteria is altered with the use of various antimicrobials is yet to be achieved. Antimicrobials are being introduced into numerous wound dressings with evidence of effectiveness being studied. Evidence of elevated proteolytic enzymes, such as matrix metalloproteases and elastase, has been found to be elevated in nonhealing wounds of many etiologies. Research will continue to study these important enzymes that can have a negative effect on healing.

Nitric oxide is another biochemical that has been studied for its applicability in wound dressings. Nitric oxide research suggests that it is involved in some stages of healing. Early in vitro and in vivo studies are showing promise as clinicians move forward with yet another concept that can improve the healing of wounds.

Skin substitutes have shown promise as a "smart" dressing, which can deliver specific growth factors to the wound. This method of gene therapy is the newest and latest research that is being tested.

In addition, wound pain has emerged as a needed focal point in wound care management. Pain at dressing removal is a frequent complaint heard from patients who have their wounds dressed with gauze dressings that have dried into their wound. Dressings that do not cause skin damage upon removal are now available. The World Union of Wound Healing Societies initiative, "Principles of Best Practice: Minimising Pain at Dressing-Related Procedures: Implementation of Pain Relieving Strategies," recommends that clinicians use dressings that minimize trauma/pain during application and removal. Although not yet available in the United States, substances within the dressing to relieve wound pain are currently used in other countries.

Since ancient times, when natural substances such as honey or mud were used on wounds, dressings have come full circle as medical-grade honey dressings are now a readily available treatment.

WOUND DRESSING DECISIONS

Wound treatment decisions must be patient centered. What are the patient’s goals and preferences? Local wound care starts with a thorough assessment of the wound and a comprehensive collection of data about the patient’s overall status. Wound assessment parameters can assist with treatment choices and decisions for appropriate dressing selection.

After a thorough wound assessment is completed, choosing dressings and treatments becomes a clinical decision that includes the patient’s overall expected outcome. Treatment goals may aim to achieve a clean wound, heal the wound, maintain a clean wound bed, prevent wound deterioration, contain odor or exudates, reduce pain, or to place the patient in another setting to continue care. Clinicians should match the wound assessment characteristics with the dressing characteristics or function. The goal of care then becomes “using the right product on the right wound at the right time.” For example, a granular, nondraining moist or wet wound needs to maintain a moisture balance conducive to healing. The primary dressing choice would be a product that maintains a moist environment but does not cause maceration or desiccation of the wound bed.

In another example, the goal of dressing selection for a necrotic draining wound is to loosen or soften the eschar for surgical debridement or to assist in autolytically debriding the wound, absorbing the excess exudate, and preventing trauma to surrounding tissue. A wound that is dry and necrotic and nonhealable would not benefit from moist wound healing. Treatment would focus on maintenance care, keeping the wound protected, and assessing for any signs of infection.

Clinicians need to reassess the wound status when completing dressing changes so that appropriate treatment interventions can be implemented. It is important to also understand that once the characteristics of the wound change, so may the dressing choice. All wound products come with product information and instructions to guide the user in appropriate use of that product, so clinicians need to read and follow them. The most appropriate dressing should be selected after considering the patient, the wound, and the site.

Dressing selections should also include an assessment of the patient’s outcome of care. High-priced, inappropriate dressings are sometimes used when a more cost-effective product would apply. Outcome is commonly driven by institutional setting. Acute care patients with length of stays of 4 to 5 days usually will not achieve healing as their outcome, but will achieve a moist, clean wound bed that supports the healing environment. Home care and long-term-care settings may have a goal of healing or maintaining the current status of the wound based on the overall health status of the patient. Wound outcomes need to be patient focused and realistic to the length of time for which a patient receives care.

The clinician needs to remember that one of the primary goals of care is the prevention of wound-related infection. Infection is a common complication of all open wounds. Open wounds are colonized with bacteria, which means that low numbers of bacteria are always present on the wound surface. Wounds that are critically colonized can be managed with antimicrobial or antiseptic dressings that provide sustained release of various agents, such as silver or cadexomer iodine. If
a wound fails to respond, clinicians should consider changing products to one with a different mechanism of action.14

The practice of using the same wound dressing during the entire healing time is no longer valid. All wounds under the care of clinicians should be assessed at a minimum of once a week and more often if notable changes occur. The type of wound, status of the wound, clinical setting, and regulatory compliance, however, may dictate a different interval of assessment.

Wound assessment is the cumulative process of observation of the actual wound, as well as observing the patient, data collection, and evaluation. For many patients, weekly reassessment will provide the indices of a successful treatment and guide decisions that suggest product changes. As the wound characteristics change, so too should the choice of the wound dressings. Indeed, several different types of products may be needed as the wound progresses through the stages of healing.

The notion that all wounds are alike has also changed. An understanding of the etiology of the wound is essential for appropriate care. Local wound care products, as well as supportive care, must be individualized for the particular wound. For example, a venous stasis ulcer might require a highly absorptive dressing, as well as the necessary compression therapy. A variety of 2- to 4-layer compression bandages beyond the classic “Unna boot” are now available. Furthermore, checking for ankle-brachial index and/or toe pressures using Doppler technology is part of the total care of a patient with a peripheral vascular ulcer or history of diabetic neuropathies.16

One example of an increased understanding of the “cellular biology” of wound healing and technology is the use of growth factors in wound care. All growth factors are proteins that are secreted by cells and have the ability to stimulate cell division, a positive action during the wound healing process.17 Growth factors are now available—derived from either a patient’s own human platelets or in a drug form dispensed in a tube to apply to wounds. Research continues as to what combination, what quantity, and when growth factors will best enhance wound healing.

Yet another way technology is providing new options for wound management is in the use of tissue-engineered skin equivalents or substitutes for healing chronic wounds.

What the future holds for the use of gene therapy in wound healing is yet to be seen. Research studying the use of gene delivery or microencapsulation in advanced wound therapy is being investigated.17

SUMMARY

Wound dressings have improved tremendously and can present a taxing decision for clinicians. Understanding the concept of moist wound healing, moisture-balanced dressings, and certainly the principles of optimal wound interventions are key concepts needed to support the healing process. As clinicians try to heal wounds faster, the marketplace continues to provide many more treatment choices. Currently, more than 500 different types of wound dressings reportedly are available to manage patients with wounds.18 Keeping abreast of wound dressing choices and various application techniques, as well as which product to use, is an ambitious task for all clinicians.

Successful wound healing depends on maintaining a moist environment. A balanced moist wound environment facilitates cellular growth and collagen proliferation within a healthy noncellular matrix.16 The right balance of moisture is critical to wound healing. Clinicians now know that other chemicals can be just as important.

Although we are gaining new knowledge regarding the biology of wound healing. “We can no longer care only for the wound itself; we must step back and look at the entire human being who happens to have a wound that needs healing.”19 Being able to differentiate among the various treatment options, when and how to apply them, in what combinations, and when to change them has indeed become an art and science.

“With the emergence of more complex products, we will be increasingly required to use these products appropriately to maximize their impact. As a better understanding of the wound environment becomes available, our ability to tailor our approach and better treat the patient as a whole increases.”20

PRACTICE PEARLS

- If the wound is dry, add moisture. If the wound has drainage, absorb it. If the wound has necrotic tissue, debride it.
- Wound dressings should be changed as needed to meet the characteristics of the wound bed.
- If a wound fails to respond, clinicians should consider changing products to one with a different mechanism of action.
- The right balance of moisture is critical to wound healing.

REFERENCES

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