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Time heals all wounds

Dr Sotirios Foutsizoglou on understanding the fundamentals of skin wound care

In recent years, significant strides have been made in our overall understanding of wound physiology. This has led directly to clinical advances that have resulted in better treatments and overall wound care. With the staggering prevalence of chronic wounds and an ever-increasing armamentarium of wound care tools, it is imperative that doctors maintain an updated understanding of wound healing biology and the principles of wound care. In this article, I will focus on the basics of wound care and highlight some of the recent advances in this dynamic and expanding field.

OVERVIEW OF WOUND CARE

A wound may be described in many ways; by its aetiology, anatomical location, by whether it is acute or chronic, by the method of closure, by its presenting symptoms or indeed by the appearance of the predominant tissue types in the wound bed.

In summary, the fundamentals of wound care consist of optimising systemic parameters such as nutrition and glucose control, reducing wound bioburden and oedema, debriding non-viable tissue, and using appropriate dressings.

It is possible to link the majority of problem wounds to a combination of three factors: age, ischaemia (including repeated episodes of ischaemia-reperfusion injury), and bacterial infection.[1] By understanding and addressing these factors, the doctor will be able to manage most wounds.

Age and Wound Healing

There is a slight, but consistent, decline in wound healing rates in the elderly. This decline is exacerbated when ischaemia and infection are superimposed. Laboratory studies reveal a functional decline in aged fibroblasts and endothelial cells that leads to accelerated senescence, diminished growth factor production, decreased stress response to hypoxia and toxins, and a reduction in collagen and matrix production.[2]

Ischaemia and Wound Healing

The role of hypoxia in wound healing is well established. In fact, local tissue hypoxia is a common characteristic of most chronic wounds. The diffusion of oxygen and nutrients from capillaries to cells is limited to a distance of 60 to 70 µm in a person breathing room air. [3] Therefore, anything that increases tissue diffusion requirements or limits available capillary delivery systems (e.g. fibrotic tissue) will establish a hypoxic environment.

Surgical and non-surgical interventions can be undertaken to maximise oxygen delivery to tissues. Examples include elevation of oedematous extremities, off-loading pressure points, debridement of necrotic tissue or foreign bodies that act as a physical barrier to diffusion, pain control that reduces sympathetic constriction of peripheral vasculature associated with the "fight-or-flight" response, heating that will result in vasodilatation of cutaneous vasculature, and smoking cessation and hydration that increase oxygen delivery at the cellular level. Recent research indicates that the benefits of ensuring adequate oxygen delivery to a wound not only are restricted to established wounds but may also be useful in preventing wound complications.[4]

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Bacteria and Wound Healing

All wounds are contaminated, but excessive numbers of bacteria will interfere with wound healing. A quantitative culture of 10 to the fifth power bacteria per gram of tissue is usually diagnostic of infection. However, this tool is rarely used because few microbiology laboratories perform the test reliably. Furthermore, more virulent strains of bacteria can establish systemic infections at much lower densities. The presence of diabetes, ischaemia, or other comorbidities will also lower the threshold needed to establish a true infection to an unknown extent.[5]

Systemic antibiotics are unnecessary for most wounds. Most wounds are open and thus adequately managed through "drainage" and proper debridements. In addition, systemic antibiotics are only delivered to adequately perfused tissues; therefore, in the setting of an abscess or necrotic tissue, they are ineffective. However, any wound that is complicated by surrounding cellulitis, increased pain and "oozing" from the skin should be treated with systemic antibiotics.[6]

WOUND CARE MANAGEMENT TOOLS

Debridement

Debridement is the single most important wound care tool to reduce bioburden and promote healing. Without adequate debridement, a wound is persistently exposed to cytotoxic stressors and competes with bacteria for scarce resources such as oxygen and nutrients.[7]

Sharp surgical debridement is the method of choice for heavily contaminated wounds or wounds with thicker levels of slough or eschar.[8] Mild debridement may also be accomplished through the use of enzymatic, mechanical, or autolytic (through host leukocyte action) means.

Enzymatic and pro-autolytic agents work through preventing the cross-linking of exudated components and impede eschar and biofilms from forming.[9] Mechanical debridement can be achieved through dressings, pressurised water devices, pulse lavage, or shower spray devices.[1]

Growth factors

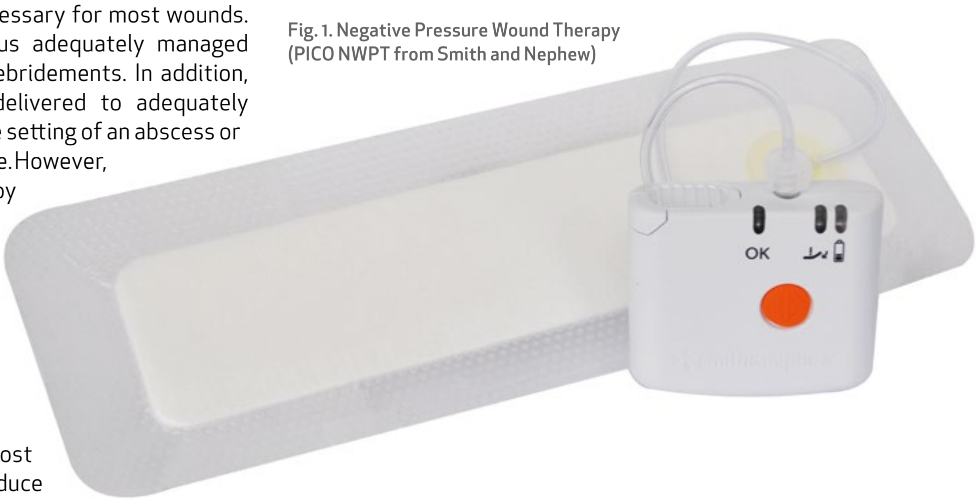
The first growth factor approved by the Food and Drug Administration (FDA) in the United States is platelet-derived growth factor (PDGF). Although it is only FDA approved for use in the treatment of diabetic foot ulcers, is has been widely used "off-label" for the treatment of a variety of other wound types including irradiated wounds and wounds in elderly patients. PDGF is only effective in the context of a well-prepared wound bed.[10] Contaminated and/or infected wound beds are filled with proteases, which will rapidly degrade the protein. In addition, its use in patients with malignancy has been cautioned.

Negative-pressure wound therapy

Negative-pressure wound therapy (NPWT) consists of the use of a porous sponge within the wound, covered by an airtight occlusive dressing, to which a vacuum is applied (Fig. 1). It has a wide range of applications ranging from lymphatic leaks to diabetic wounds.

NPWT works through multiple important mechanisms including reduction of oedema and removal of wound fluid rich in deleterious enzymes, both patient and bacteria derived. In addition, the cyclic compression and relaxation of the wound tissue likely stimulates mechanotransduction pathways that result in increased growth factor release, matrix production, and cellular proliferation.[1,10] >

Fig. 1. Negative Pressure Wound Therapy (PICO NWPT from Smith and Nephew)



Dressings

We have all paused to ask ourselves 'What dressing shall I use on that?' Knowledge of the correct type or class of dressing for a particular wound is important as the right dressing for the right wound can make a great deal of difference to healing time. The ideal dressing should be sterile, non-toxic, non-allergenic and non-adherent. It should keep the wound moist and prevent desiccation, a common factor contributing to poor wound healing and poor epithelialization, absorb wound exudates, provide mechanical and bacterial protection, and allow gaseous and fluid exchange.

Wound care dressings can be broadly divided into seven classes: films, composites, hydrogels, hydrocolloids, alginates, foams, and absorptive dressings including NPWT. Films can be used for incisions, and hydrogels or hydrocolloids can be used for open wounds. The amount and type of exudate that is present in the wound will determine the dressing used in wounds that have some degree of bacterial colonisation.

In general, hydrogels, films, and composite dressings are best for wounds with lighter amounts of exudates; hydrocolloids are used for wounds with moderate quantities; and alginates, foams, and NPWT are best used for wounds with heavier volumes of exudates. As mentioned previously, NPWT is also useful for wounds with heavy amounts of lymph drainage as a consequence of a lymphatic leak, as well as for fistulae.[11] Wounds with large amounts of necrotic material should not be treated with dressings until a surgical debridement has been performed.

Stem cells

Significant research is underway in the biology and tissue engineering potential of autologous stem cells. Several stem cell populations have been identified in the skin and are increasingly studied as potential therapies for wound repair. These progenitor populations include epidermal stem cells, hair follicle stem cells, and adipose-derived stem cells that have the capacity to restore almost all skin compartments.[13] It is well known that stem cells play a key role in normal wound healing; the question for researchers is how to exploit these powerful cell populations to promote cutaneous repair.[14]

CONCLUSION

Understanding the fundamental aspects behind the chronic and problem wound, strategies can be employed to alter the wound environment and tip the balance toward healing. Basic science research and findings continue to advance our knowledge of wounds and assist in the development of novel treatment approaches. Unfortunately, many of the wound care products in use today are market and industry driven, with little prospective, randomised comparative studies evaluating efficacy.

In my next article, I will explore the different dressing materials, their properties, indications, and evidence based advantages and disadvantages of their application in chronic and acute wounds. **AM**

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