Wound management

Wounds International's clinical innovations section presents recent developments in wound care. This issue, we focus on innovations in wound management discussed in presentations given at the recent Wounds International conference held in Kuala Lumpur on 11–18 October 2013.

Addressing the vertical and horizontal aspects of the wound by using negative pressure wound therapy and growth factors

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Any wound can be simplified into the vertical and horizontal aspects of defect[1]. The vertical wound depicts the defect from the skin and down (dead space), whereas the horizontal wound depicts the actual skin loss. It is our goal to address these two issues in order to achieve wound healing.

In cases with both a vertical and horizontal wound, it is preferable to reconstruct with a flap that provides sufficient tissue to obliterate the dead space, and at the same time a flap that has a skin paddle to cover the skin loss. A three-dimensional reconstruction can achieve positive results in complex wounds. However, in cases where microsurgery/flap surgery is not available, alternative options must be found.

NEGATIVE PRESSURE WOUND THERAPY

Negative pressure wound therapy (NPWT) was introduced in 1997 and its use has been extended to managing many types of wounds, including diabetic foot ulcers, pressure ulcers, the open abdomen, chest wounds, skin grafts and traumatic lower extremity wounds[2,3,4]. It is now considered to be one of the major advanced treatments for difficult wounds.

The mechanism of action of NPWT in wound healing is not fully understood, but numerous studies have attempted to show its effects in many scenarios. Broadly, NPWT facilitates the drainage of excessive fluid and debris from a wound, and thus results in decreased bacterial counts and interstitial oedema, stimulation of granulation tissue formation and increased regional blood flow[3,4].

Animal experiments conducted by Argenta and Morykwas[2,3] suggested that –125 mmHg is the optimal negative pressure to increase blood flow, and has now been generally accepted as the clinical standard for NPWT application.

Various modes of NPWT have been introduced, namely continuous and intermittent. A third option is the cyclic mode, which operates its negative pressure in a style similar to a sine wave by oscillating between the designated negative pressures (Curasys®, Curavac®; Daewoong Pharmaceutical). Once it hits the upper target pressure of –125 mmHg, the system shuts off and the pressure slowly drops until the lower target pressure is reached, regardless of the time frame. As the change in the intralesional pressure is measured, the falling velocity of the pressure is closely associated with the defect volume in the cyclic mode. In other words, the larger the volume of defect, the shorter the time taken for completing one cycle of the system. Thus, the pressure movement is regulated by the preset pressures and the volume of defect, not by a specific time frame. It has the same efficacy as the intermittent mode, but with reduced pain as the pressure is not dropped to 0 mmHg [Hong et al, in press].

Although there has been debate about the microvascular perfusion at the wound edge and wound healing, it is generally believed that the improved microvascular blood flow at the wound edge achievable with NPWT has beneficial effects on wound healing[5]. NPWT's effect on increased tissue perfusion is thought to be beneficial, especially for treating ischaemic wounds. Therefore, when microsurgical reconstruction is not an option, NPWT is an efficient way to stimulate the production of granulation tissue to reduce wound depth.

In patients presenting with loose skin margins, serial sutures to pull the wound margins inward while applying NPWT can be an effective method to reduce the wound width, as well as fill the vertical defect with granulation tissue. NPWT is also useful in cases where amputation stump sites are difficult to close or have dehisced after repair. Often, there is a small dead space where fluid collects and eventually drains through the repaired site. NPWT can stimulate granulation to fill the dead space. During any application of NPWT, the end-point is when granulation tissue has filled the vertical aspect of the wound or covered all pre-exposed vital structures in the wound. Once this has been achieved, the horizontal aspect should be treated.

Once NPWT has been successfully administered, a flap or skin graft can be applied. In small or moderately sized wounds, secondary intention healing can be pursued. In cases where secondary intention will take too long or in cases when a skin graft is not available, or to expedite healing for secondary intention or grafting, growth factors can be considered to promote healing.

EPIDERMAL GROWTH FACTOR

Epidermal growth factor (EGF) — which is produced by platelets, macrophages and monocytes — interacts with EGF receptors on epidermal cells and fibroblasts[6]. EGF primarily acts to stimulate epithelial cell growth across the wound, and also acts on fibroblasts and smooth muscle cells. A number of studies have demonstrated the effects of EGF on wounds through the shortening of healing time, increasing the tensile strength of the skin and reducing unfavourable tissue effects[7,8]. EGF is also known to positively feedback to increase the EGF receptors.

Debridement of necrotic tissue, infection control, maintaining a moist wound environment and providing abundant oxygenation to the tissue are all essential elements of wound care. However, despite these efforts, chronic wounds may still be resistant to treatment. One reason for delayed healing in chronic wounds despite the implementation of good wound care practices may be found in lack of growth factors[9].

The author studied this hypothesis in a crossover study[10] (a longitudinal study where subjects received a sequence of different treatments), in which diabetic foot ulcers of >6 months' duration were debrided and treated with hydrocolloids or composite dressings (i.e. foams, Versiva [ConvaTec] or Aquacel® foam [ConvaTec]), depending on the condition of the wound. If treatment effect was minimal using advanced dressings for 3 weeks, patients were switched to twice-daily treatment with 0.005% EGF and advanced dressings. Among the patients, 21 showed improvement using hydrocolloid or composite dressing alone, and 68 were crossed over to treatment with EGF and advanced dressing. Among the EGF-treated patients, complete healing was noted in 52 patients within an average of 46 days (range, 2–14 weeks).

The approach to wait for good standard of care to take effect and use EGF only in cases where wound healing is delayed over several weeks has become the standard of practice. EGF is also used in cases where NPWT has successfully achieved granulation but epithelialisation (horizontal healing) becomes a priority.

CONCLUSIONS

Wounds need to be addressed in both the vertical and horizontal aspects. The vertical aspect depicts the dead space underneath the skin, where the wound can affect muscles, tendon and bones. NPWT provides an efficient way to enhance healing by increasing granulation, thus improving the vertical aspect of the wound. Once granulation is reached at the skin level, the horizontal aspect (epithelialisation) must be adressed. EGF can lead to rapid, effective skin closure by enhancing keratinocyte activity. This combination can be used in cases where the wound is of moderate size to avoid skin grafts and to achieve efficient healing. ■

AUTHOR DETAILS

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