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Role of Cyclic Negative Pressure Wound Therapy in Thermal Burns

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Abstract

Thermal Burns are a major cause of morbidity. They cause both time and financial burden on the patient and caregiver. Over the years, there has been drastic improvement in modalities used in treatment of Thermal Burns. The recent treatment options include use of negative pressure wound therapy. We would like to share our experience in the management of Thermal burns with Cyclic NPWT. A common treatment for both acute and chronic wounds is negative pressure wound therapy. NPWT is recommended for a range of difficult wounds, and certain research support its usage in specific burn care procedures. Even though more study is required to fully understand the advantages for burns, NPWT has shown promise as a dressing that supports skin grafts, encourages the integration of bilaminate dermal substitutes, encourages the re-epithelialization of skin graft donor sites, and may even lessen the zone of stasis. Based on indication/application, this article analyses the literature on NPWT in burns and discusses our experience with modified NPWT for major burns.

Keywords: Cyclic Negative Pressure Wound Therapy; Thermal Burns; Wounds.

INTRODUCTION

Applying negative pressure wound therapy together with the proper debridement and antibiotic treatment as judged clinically necessary can help manage infected wounds. NPWT encourages perfusion surrounding the wounds in addition to removing fluid and reducing oedema. Additionally, when used as a bolster, NPWT may result in improved graft fixation, particularly in patients who are less co-operative or who have poor graft fixation as a result of employing conventional procedures. In patients who are young, active, and less obedient, NPWT is an excellent option to support skin grafts. In order to better control post-operative infection, we suggest an improved segmental compartment covered approach that includes NPWT as an additional first line wound care. Additionally, NPWT encourages the development of granulation tissue to prepare the wound bed for a subsequent skin graft and can be utilized. Dehydration, inhalation injury, infection control, and nutritional support are urgent needs for burn victims. Additionally, escharotomy, followed by skin grafting, is the most crucial procedure to boost the survival probability. Burn patients

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remain immunosuppressed, hypermetabolic, and painfully sensitive throughout this period. The difficulties in treating individuals with severe burns are controlling early wound exudate and providing postoperative care following skin graft. A dressing should ideally be able to shield the area from external pollutants, avoid traumatising or damaging the wound, and lessen patient discomfort brought on by dressing changes. Negative pressure wound therapy may be used to treat various issues, such as wound infection brought on by the early stage's large exudate. According to earlier studies, NPWT increases the circulation around the wound while also removing exudate and infectious materials. Additionally, it has been noted that NPWT, when used as a support, can aid in promoting graft take and may lower the chance of needing additional skin grafts. Finally, adopting NPWT for burn patients' wounds may shorten the time spent providing nursing care. We suggest the use of cyclic NPWT for treating burn patients.

MATERIALS AND METHODS

This research was done in a tertiary care hospital in the department of plastic Surgery. The patient who was the subject of the study provided informed consent. The 16 year old female patient and had no other known comorbidities. The patient had second degree deep burns and third degree burns to her bilateral lower limbs (Fig. 1).

Fig. 1: Thermal burns involving bilateral lower limb and post tangential excision and skin grafting.

According to TIME concept described in the recommendations, the wound bed was prepared and the ulcer was serially examined and document the Bates Jensen wound evaluation method. The management of non-viable necrotic tissue involved numerous sessions of surgical and hydro debridement. Local antibiotics and antimicrobials were used to treat the infection. Cyclic NPWT was applied to the burns wound after admission (Fig. 2).

Fig. 2: Application of Cyclical NPWT

It helps in reducing the pain post burns and prepare the wound for tangential excision. Patient underwent tangential excision and skin grafting for the deeper burn wounds (Fig. 3).

Fig. 3: Post tangential excision and skin grafting.

Post tangential excision patient underwent repeat cyclic NPWT which helps in fasten the wound healing and increase the uptake of skin grafting (Fig. 4).

Fig. 4: Healed burn wound day 18

Cyclic negative pressure wound therapy was used to regulate moisture because the wound was naturally moist. Two sessions of cyclic negative pressure wound therapy was given. The pressure in Cyclic NPWT was between 50 mmHg to 125 mmHg changing from time to time as by machine controlled.

RESULTS

Wound bed gradually improved, clinical decision was taken to reconstruct with skin grafting. The patient compliance to Cyclic NPWT is good with less pain and fasten the wound healing. It decreases the repeated change of exudative soakage of external dressing.

DISCUSSION

Thermal Burns are due to arrest in one of the stages of wound healing. In our study we have noted from the patient that the size of the wound was almost constant for more than 2 weeks when they presented to the hospital. So, to accelerate wound healing adjuvant methods of treatment NPWT and APRP were given.[1] NPWT requires a device which is connected through a special set that generates a negative pressure over the wound bed. Various mechanisms that are thought to act both at tissue and cellular level include reduction of the edema, improvement of local blood flow, induction of angiogenesis and granulation, wound margin epithelialization, and facilitation of cell migration and proliferation.[2] Macrostrain mechanisms of NPWT involve removal of exudates and infectious materials and contraction of wound margin. NPWT has been shown to be safe and effective in post debridement wounds. Hence NPWT was started, and size of the wound was measured at the time of change of dressing. By the end of 6 weeks there was a significant decrease in the size of the wounds and the wound was covered with healthy granulation tissue in 4 patients and one wound healed completely.[3] One of the complications of NPWT, excessive bleeding was not noted in our patients. Platelets act as regulators of inflammation, angiogenesis, cell migration, and proliferation with the release of various growth factors and anti-inflammatory cytokines which is thought to help in faster and better healing of the wounds. Since we applied NPWT immediately at each setting it was prudent to inject the APRP rather than spray it.In our experience it was noted that irrespective of the aetiology of the wound and the comorbidities there was a visible decrease in the size of the wound, with formation of healthy granulation tissue. The cyclic mode operates its negative pressure in a manner similar to the sine wave by cycling through the designated negative pressures.[4] Once it hits the upper target pressure of 125 mmHg, the pressure system shuts off and the pressure slowly drops till the lower target pressure is reached, regardless of time. As the change in the intralesional pressure is measured, the drop 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.[5]

Improved tensile strength in in vivo research has previously showed increased collagen I production in wound healing. This rise could be owing to the pro-angiogenic effect of increased vascular endothelial growth factor and fibroblast growth factor levels. Both growth factors are involved in the wound healing process, namely in the stages of haemostasis, proliferation, and repair, and so influence wound healing. VEGF also controls cell proliferation, differentiation, and migration during angiogenesis. This encourages the creation of new capillaries, allowing for better circulation to the wound site and hence the delivery of critical nutrients and oxygen. The increased expression of certain mediators, such as IL-1 and monocyte Chemo attractant Protein-1, causes VEGF to be stimulated (MCP-1).

Human and animal's studies have shown increased growth of granulation tissue, increased blood flow, diminution of the wound area, and regulation of inflammatory response with VAC therapy. VAC causes wound contraction, stabilization of the wound environment, decreased oedema with removal of wound exudates, and micro deformation of cells. These effects allow VAC to accelerate wound healing by virtue of increase blood flow; reduced bacterial load; and improved wound bed preparation for subsequent coverage.[6] The compression of tissue by negative pressure causes tissue hypoxia due to decreases perfusion beneath the foam which stimulates angio-neogenesis, and local vasodilatation due to release of nitric oxide.

Micro deformation/micro strain of cells due to VAC causes tissue expansion effect with release of growth factors. This tissue expansion effect is due to the differential pressure in the tissues after negative pressure application. The pressure within the cells is positive; while the pressure outside the cells and beneath the dressing is negative. This may lead to expansion of cells, growth of granulation tissue and pulling of wound edges closer to one another reducing wound size.

CONCLUSION

Cyclic application ofnegative pressure results in a superior local enhancement of cutaneous microcirculation with regards to blood flow and consecutive tissue oxygenation. Beyond that, repeated alterations between different levels of negative pressure due to cyclic application represent a greater stimulus for remote conditioning effects, indicating a superior local interaction with the underlying tissue.[5] Hence, we were able to manage Thermal burns using cyclic NPWT successfully however it needs large scale randomized trials for application in clinical practice.

Conflicts of interest: None.

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