Original Article

Journal of Plastic Surgery and Transplantation
Volume 5 Number 2, July–December 2024

Role of Cyclical Negative Pressure Wound Therapy in Burn Patients

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How to cite this article:

Nishant Visvas Dumont, Ravi Kumar Chittoria, Kanav Gupta, Jacob Antony Chakiath, Padmalakshmi Bharathi Mohan, Role of Cyclical Negative Pressure Wound Therapy in Burn Patients. J of Pla Sur and Trans. 2024;5(2): 59-63.

Abstract

The use of "negative pressure" has become a cornerstone in the treatment of acute and chronic injuries in almost all specialties. Continuous alternating, cyclic are three types of negative pressure wound therapy (NPWT). Cyclic NPWT is similar to intermittent in that it uses the same maximum air pressure, but the pressure never reaches zero in the cyclic mode. Cyclic application of "negative pressure" leads to excellent local skin microcirculation in terms of blood flow and subsequent tissue oxygenation. This article compared cyclic NPWT with other NPWTs.

Keywords: Negative pressure wound therapy, cyclic, wound.

INTRODUCTION

Since the presentation of the negative weight wound treatment (NPWT) framework by Morykwas and Argenta, it has been connected to a number of wounds and has gotten to be an persuasive and successful procedure for recuperating basic and complex wounds. The routine NPWT framework receives either 'intermittent' or 'continuous' mode.

Whereas the persistent mode always applies a sub-atmospheric weight of −125 mmHg, the discontinuous mode makes a sub-atmospheric weight of −125 mmHg for 5 minutes and a 2-minute resting stage of mmHg.

In tests performed on creature models, the irregular mode appeared expanded perfusion level and arrangement of granulation tissue within the wound zone compared with the persistent mode. In spite of the viability of irregular mode in wound recuperating, it has been maintained a strategic distance from in clinical application since of the torment happening each few minutes amid the start stage of the framework to reach −125 mmHg[1,2]. Hence, 'cyclic' mode would minimize the torment whereas keeping up the prevalent adequacy of the discontinuous mode.

The cyclic NPWT framework is comparable to the discontinuous mode in terms of utilizing the same maximal sub barometrical weight, but the pressure never comes to zero within the cyclic mode. So, it persistently makes certain weight angle that sways between −125 mmHg and the preset sub

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Received on: 30-05-2024

Accepted on: 04-07-2024

barometrical weight. The cycle runs based on the changes in sub air weight, not time, and in this way its recurrence reflects the wound volume

MATERIALS AND METHODS

The study is done in a tertiary-care hospital in South India. The subject is a82 years old male patient, withalleged history of accidental thermal burn 1 month back involving right thigh region (fig. 1). The patient had undergone multiple dressings of functional regenerative therapy with scaffold and cyclical NPWT. ABSI Score 5. Cyclical NPWT five applications were done, following which allografting of SSG was done (Fig. 2)

RESULTS

Cyclical NPWT is useful in improving the wound healing of burns in adult patients (fig. 3).

BACKGROUND

In recent decades, the use of "negative pressure" has become a cornerstone in the treatment of acute and chronic injuries in almost all specialties. Several available synonyms reflect past and present applications of the technology, including "vacuum-assisted closure" (VAC), "negative pressure wound therapy" (NPWT), "closed incision negative pressure therapy" (ciNPT), or "negative pressure wound". therapy." by instillation" (NPWTi)[3]. All but ciNPT are used to treat open wounds and have known beneficial effects of "negative pressure" therapy on wound healing, ie. adequate temporary wound closure, promotion of wound bed granulation, mechanical contraction and stabilization of airwaysand effective reduction of bacterial perfusion is another key factor in wound healing. The effect of "negative pressure" on wound bed perfusion has been widely discussed recently.

Types of NPWT

1. Continuous NPWT - The continuous mode constantly applies a sub-atmospheric pressure of −125 mmHg.
2. Intermittent NPWT - The intermittent mode creates a sub-atmospheric pressure of −125 mmHg for 5 minutes and a 2-minute resting phase of 0 mmHg.
3. Cyclic NPWT - The cyclic NPWT system is similar to the intermittent mode in terms of using the same maximal sub atmospheric pressure, but the pressure never reaches zero in the cyclic mode. So, it continuously creates certain pressure gradient that oscillates between −125 mmHg and the preset sub atmospheric pressure.

The results of different research groups partially showed inconsistent results, which can seriously question the hypothesis of improvement of local and adjacent wound bed perfusion due to the use of negative pressure dressings. compression of the underlying tissues using a negative pressure bandage, especially over the capillary network under surface pressure. Successive microvascular occlusion would result in decreased rather than increased capillary blood flow, leading to local hypoxia and likely ischemia. In addition, an otherwise widely used perfusion analysis technique, laser Doppler velocimetry, has been suspected to be flawed due to the effects of "pressure artifacts", leading to a false positive sign of improvement in underlying perfusion. applied NPWT bandage.

In contrast, the present study of ciNPT-induced perfusion changes and closed-incision negative pressure wound therapy found that blood flow and subsequent tissue oxygenation improved dramatically during treatment. In addition, NPWT has also been successfully used. free treatment tissue transfer, while postoperative tissue damage decreased instead of increasing[10]. No negative effects of negative pressure were observed. In a previous analysis, we used continuous laser Doppler flowmetry combined with white light spectroscopy to perform a comprehensive real-time analysis of microcirculatory changes under an NPWT dressing[8]. Application of alternating negative pressure resulted in a gradual increase in local tissue perfusion. a sequential increase in tissue oxygen saturation.

DISCUSSION

In this preclinical study on acute changes in skin microcirculation under an applied NPWT bandage, we observed a significant increase in local perfusion dynamics with a sequential improvement in tissue oxygen saturation.

It is interesting that all three compared application methods, continuous, intermittent and cyclic, locally improved microcirculation to a greater or lesser extent.

Comparing different application modes, we found an excellent effect on local and remote perfusion in the cyclic group.

Continuous regimen was the most common setting in clinical wound care Suissan *et al.* according to a published meta-analysis. in 2011, when intermittent applications were rarely reported[12].

Continuous treatment is the generally accepted standard of care, despite already existing early evidence of superiority of intermittent NPWT for granulation tissue formation or angiogenesis. This is probably because the periodic activation of "negative pressure", which causes repeated spikes of surface pressure in the wound, is thought to be unpleasant.

Recently, the introduction of the "cyclic regimen" appears to be a promising compromise combining both patient satisfaction and excellent wound care[13]. Pain levels were generally low with cyclic NPWT.

In human skin microcirculation, the resting capillary pressure varied from 10.5 to 22.5 mmHg or even 41.0 mmHg[14,15]. Thus, a surface pressure of approximately 30.0 mmHg through the NPWT bandage can cause skin capillary occlusion. Considering the observation that capillary pressure also increases in response to higher venous pressure, it can be assumed that the intervention is due to at least a subtotal occlusion of the skin microvasculature[16]. In general, the response mechanisms of the skin vasculature to certain stimuli complex, especially in relation to vasodilatation and improvement of local flow[17]. Repeated capillary occlusion (subtotal) is a strong stimulus to damaged tissue. Both post-occlusive reactive hyperemia (PORHA) and increased mechano-humorous transduction to the vascular bed lead to changes in intravascular shear stress and can cause the better effect in the intermittent and especially the cyclic group[18,19]. We also evaluated the. skin microcirculation changes in the contralateral thigh and found stronger effects in the cyclic group. Previous research on Remote Ischemic Conditioning (RIC) has shown that changes in the applied stimulus can affect the onset of skin perfusion[20,21]

The duration of applied pressure, the number of repetition cycles and body region are important variables in optimizing rehabilitation effect on improving remote microcirculation.

Variables affected by NPWT

The skin capillary network can be examined for blood flow (BF), velocity (VELO), postcapillary oxygen saturation (StO2), and relative hemoglobin concentration (rHb).[11]

Blood Flow (BF)

Regardless of application. Different pressure levels, suction intervals and skin circulation under the foam dressing were significantly improved in all three types.

Postcapillary tissue oxygen saturation (StO2)

Corresponding to the improvement in skin BF, StO2 values increased steadily when suction was active.

Relative hemoglobin (rHb) and erythrocyte velocity (VELO)

Both parameters were significantly altered by the NPWT stimulation.

Pain/Discomfort

As expected, reported levels of discomfort were nominal. No statistical difference was observed between the groups in the comparison of the maximum values ($p > 0.05$).

Surface pressure

The suction used caused significant changes in the surface pressure (sp) of the underlying skin.

Remote effects

NPWT treatment also affected the microcirculation of the skin of the contralateral thigh. This shows an almost linear increase in BF 90 min in all three types.

Advantage of cyclic NPWT

1. Less painful when compared to intermittent NPWT.
2. Superior effects on local and remote cutaneous perfusion in the cyclic type compared to others.

Disadvantage of cyclic NPWT

1. Requires expansive devices to fluctuate between sub atmospheric pressure.
2. To perform cyclic NPWT in classic suction device is cumbersome.

The ideal use of NPWT dressing should take into account the individual circumstances of each patient and treated wound, related to comorbidities, wound location and tissue composition[22].

CONCLUSION

Cyclic application of "negative pressure" provides excellent local. improvement according to skin microcirculation blood flow and tissue oxidation. In addition, repeated changes between different levels of "negative pressure" resulting

from cyclic use are a greater stimulus for teletherapy effect, indicating a better local interaction with the underlying tissue. Further studies are warranted to investigate the correlation between increased local perfusion and granulation tissue formation induced by cyclic NPWT in humans.

Fig. 1: Raw area at the time of admission BJWAT score 32

Fig. 2: Patient undergoing cyclic NPWT

Fig. 3: After 5 cycles of NPWT BJWAT score 25

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