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RESEARCH ARTICLE

NEGATIVE PRESSURE WOUND THERAPY (NPWT): FOR ACCELERATED WOUND HEALING IN CHRONIC AND INFECTIVE WOUNDS

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ABSTRACT

Sugarcane i Negative pressure wound therapy (NPWT) represents an alternative method to optimize conditions for wound healing. Delayed wound closure is a significant health problem, which is directly associated with pain and suffering from patient's aspect, as well with social and financial burden. Negative pressure wound therapy (NPWT) is used to promote wound healing in a wide range of difficult to manage acute and chronic wounds. This data review reports the results of 10 patients who were treated with Vacuum-Assisted Closure Ò (VAC) negative pressure therapy system.

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INTRODUCTION

Vacuum-assisted closure (VAC) therapy is a recognised efficient tool in the wound- care setting. Chronic infective large wound, have had great success with the application of this therapy (Gabriel 2006 and Armstrong, 2005). Argenta and Morykwas in 1995 applied the principle of sub atmospheric wound therapy in treating acute and chronic infective wounds (Morykwas, 1997 and Saxena, 2004). By delivering mechanical stress to the underlying tissue the Negative Pressure Wound therapy (NPWT) removes the third space fluids and collects it in the collection canister. NPWT stretches the cytoskeleton and causes release of intracellular messengers resulting in matrix molecule synthesis and cell proliferation (Buttenschoen, 2001). Scientific studies have reported that VAC therapy enhances blood flow (Wackenfors, 2004 and Wackenfors, 2005) and increases proliferation of granulation tissue (Oczenski, 2004 and Morykwas, 2001). Compared to moist wound care dressing this therapy decreases the wound size faster (Joseph, 2000 and Armstrong, 2002) and thereby effecting the timing of bolstering a skin graft (Gupta, 2004 and Moisidis, 2004).

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As a closed system, Negative Pressure Wound Therapy (NPWT) delivered by vacuum-assisted closure (VAC) provides a moist wound-healing environment and helps protect wounds from outside bacteria (Petrie, 2002 and Webb, 2002). Delayed primary,or secondary closure remains the mainstay of treatment of heavily contaminated chronic infective wounds.

Technique: VAC uses open cell polyurethane ether foam (which is FDA approved for open wounds) as a dressing (Webb, 2002). The pore size is generally 400–600 mm (thought optimal for tissue growth). This foam is cut to fit and closely applied to the selected wounds. An evacuation tube with side ports, which communicate with the reticulated foam, is embedded in it. The aim of the reticulation being that the negative pressure will be applied equally to the entire wound bed. An adhesive drape is then applied over the area with an additional 3–5 cm border of intact skin to provide an intact seal. The evacuation tube is connected to an adjustable vacuum pump and a canister for collection of effluent. The pump can be adjusted in terms of both the timing (intermittent vs. continuous) and magnitude of the vacuum effect. In general an intermittent cycle (5 min on, 2 min off) is employed as this has been shown to be most beneficial. Guidelines have been produced to aid in administration of this technique (Table 1). Effectively the technique converts an open wound into a controlled and temporarily closed environment.

- Gently remove previous dressing and discard as per local institutional protocol
- Aggressively cleanse wound and peri-wound area
- Debride necrotic tissue if applicable
- Achieve haemostasis
- Shave bordering hair if necessary
- Dry and prepare the peri-wound skin
- Select appropriate foam dressing
- Select appropriate sponge kit to fill the cavity
- Size and trim the drape to cover an area around the wound large enough to secure the foam and to maintain an air tight seal
- Gently place the foam into the cavity covering the entire wound base including sides, tunneling and undermining
- Apply tubing to the foam
- Cover the foam and an area of healthy surrounding tissue with the drape in order to accomplish an airtight seal
- Attach tubing from the wound to tubing in the canister placed in the VAC unit. Ensure clamps are unclamped
- Program the appropriate pressure and cycle in the computerized unit and begin treatment (Fig-1&2)

Fig. 1&2. Negative Pressure woundtherapy

MATERIALS AND METHODS

In our study we have taken 10 patients satisfying all the inclusion criteria (Table 1), and strict precautions (Table 2) were followed before applying NPWT, the response to therapy of the wound with respect to the virulence of the organism on the wound bed in between the NPWT cycles (Table 3), wound depth and timing of the secondary closure (SSG, secondary suturing) were noted. NPWT has a great impact on these parameters and accelerates the process of wound healing and better control of infection avoiding the need for lengthy stays in the hospitals for debridement and dressing of chronic non healing infective wounds.

Inclussion Criteria

- Large ulcers min diameter 15 cm and above in greatest dimension
- Diabetic ulcers
- Necrotizing soft tissue infections (NSTI) Ex- Fourniers Gangrene
- Pressure sores.

Exclusion Criteria

- Malignancy
- Active bleeding
- Visible vessel of the ulcer bed
- Drugs(Anti coagulants, Chemotherapy)
- Prior Irradiation.

Methods

A study group of 10 patients where selected based on the inclusion criteria, infected large wounds with co-morbid conditions were given the first preference in application of NPWT. Bacterial culture on the day and the subsequent days of the dressing sent. Over all the time for secondary closure has decreased, thereby the NPWT has an impressive impact on the length of hospital stay in chronic non healing infective wounds. Frequent debridements maintains the wound in a healthy state by removing the inhibitors of wound healing (metalloproteases, including the colla- genases matrix metalloproteinase 1 and 8 and elastases) and allowing the growth factors to function more effectively (Kirshen, 2006). NPWT coverts a chronic non healing wound into an acute one by consistently removing the inhibitory stimulus on the wound (Nwomeh, 1999). Wound infection was assessed on THE ASEPSIS score, which takes into account the Erythema, Purulentdischarge, Separation of deeper tissues, Stay in the hospital. The NPWT, has a tremendous impact on the length of hospital stay by accelerated wound healing, there by allowing secondary closure (SSG, Secondary suturing) in the treatment of chronic infective non healing wounds.

RESULTS

As the Advances Guidelines in the control of wound infection in chronic wounds suggests to create an environment that is conducive to normal and timely healing.

Table 1. NPWT Cycles

Action	Day	Result
VAC application	1st day	Culture of bacteria positive
1st Dressing change	4th day	Negative for culture
2nd Dressing change	7th day	Decreased wound depth
3rd Dressing change	10th day	Negative for culture
4th Dressing change	13th day	Preparation for wound closure

To achieve this goal, one first has to address and evaluate the underlying issue (disease) to optimise healing. Secondly, most wounds require some form of debridement, if appropriate. Debriding a chronic wound enables it to go through the normal wound-healing phases, assuming that systemic and local

Table 2. Before NPWT Application

Diagnosis	Wound Area	Initial culture	Wound Infection
Fourniers Gangrene	20 cm*15cm	clostridium Welchi	Severe
Diabetic foot	15cm*15cm	MRSA	Moderate-Severe
Venous ulcer	15cm*10cm	VRE, Staphylococcus	Severe
Artierial ulcer	20cm*15cm	MRSA,VRE	Moderate-Severe
NTSI Groin	20cm*20cm	Clostridium Welchi, Staphylococcus	Severe
Grade 3 bed sore	15cm*15cm	Enterococcus, VRE	Moderate
Cellulitis with extensive soft tissue loss	16cm*15cm	MRSA,VRE	Severe
Diabetic toe access with amputation of the toe	10cm*15cm	Enterococcus	Moderate
NSTI, post fasciotomy leg.	10cm*2cm	Staphylococcus, Enterococcus	Moderate-Severe
Chronic non healing wound	15cm815cm	MRSA,VRE	Moderate

Table 3. Follow up with npwt cycles

Dressing days	Wound infection	Bacterial culture	Secondary closure
1st	Severe	positive	not done
2nd	Moderate	negative	not done
3rd	mild	negative	not done
4th	healthy	negative	done

factors are functioning normally. NPWT accelerates the wound healing makes the wound bed conducive for secondary closure of the raw area. In this way the NPWT decreases the hospital stay in patients with chronic infective non healing wounds.

DISCUSSION

NPWT, or else known among others as VAC, micro deformational wound therapy (MDWT), topical negative pressure therapy (TNP), sub atmospheric wound therapy (SWT) consists a new weapon in the armamentorium of a surgeon in managing any complex non healing infective wound, that require more than conventional, conservative treatment. The VAC system has three main components: a type of sponge that fits the wound size, an adherent dressing, put as an airtight seal over the wound and a device that provides negative pressure to the wound bed and dressing. Special attention should be given to certain parameters such as the pressure power, the sponge type, the use of instillation, the solution used, the structure-geometry of the wound and the frequency of dressing changes. The negative pressure, values in the literature range from "75 mmHg to "125 mmHg, it is strongly recommended that in cases of highly infected exudates, a pressure of "125 mmHg is most beneficial (Banwell, 2003). Generally, the maximum pressure that does not cause pain or discomfort to the patient is the desired and the most effective. Moreover, constant pressure appears to be superior to intermediate.

Dressing changes are recommended every 2 or 4 days (Banwell, *2003*). The most common material used for ponge formation is polyurethane, an hydrophobic reticulated foam, with tiny pores that creates thousands of suction cups on the wound surface when vacuum is applied (Kubek, 2013). Polyvinyl Alcohol (PVA) foam and Granu Foam Silver (GFS) are other, less used sponge materials. The type of sponge and the use of instillation are directly related to the type of the wound, its localization, and the level of exudate. Of these parameters, the use of instillation significantly predominates. Yusuf E *et al*. (Yusuf, 2013), claim that bacterial load remains high in NPWT sponges, and routine changing does not reduce the load. Therefore, the significance of the instillation is evident. Depending on the culture results, the recommended solutions are: Hypochloride based solutions (e.g. Hypochlorous acid, Sodium hypochloride), silver nitrate (0,5%), sulfur-based solutions (sulfon- amides), biguanides (Polyhexanide), acetic acid, cationic solutions (Octenidine, Benzalkonium Chloride) and isotonic solutions (Raad, 2001). Finally, the geometry of the wound and the included tissues are playing an important role in the way that the foam will be instilled, succeeding optimum result without incurring the flanking regions. Chronic Infective non healing wounds managed with NPWT benefit from significant reduction in the wound infection, bacterial culture and the time taken for delayed primary or secondary closure of the wound to less than 2 weeks. Therefore NPWT has become a useful option in the management of chronic infective non healing wounds. It can be applied with effectiveness to treat chronic and complex wounds, and several studies have shown it to be more effective than traditional moist therapy in terms of healing and rate of wound closure. Before the application, it is mandatory to apply the standard care, to ensure an adequate blood flow in the wound area and to exclude an infectious process that could affect the deeper tissues. The mechanism of action, partly unclear, determines a favourable wound environment to promote and accelerate the healing process. NPWT reduces perilesional edema, allows the removal of infected fluid and exudate, increases blood flow and stimulates angiogenesis, granulation tissue and cell proliferation. Furthermore this medication creates an appropriate wound bed for a possible application of skin graft and flap surgery. Although excellent results are documented with the use of NPWT, further studies are needed to better define its use, the optimal pressure level, the use of intermittent or continuous pressure and the filler material covering the wound. In conclusion, we retain that currently, between advanced dressing, topical negative pressure plays a leading role in the field of diabetic foot, and physicians can use this medication to treat chronic and complex wounds with excellent benefits.

Conclusion

NPWT has become a useful option in the management of chronic infective non healing wounds. It can be applied with effectiveness to treat chronic and complex wounds, and several studies have shown it to be more effective than traditional moist therapy in terms of healing and rate of wound closure.

Conflict of Interest: There is no conflict of interest in this study and no funding for this study.

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