

Original Research Article

A STUDY ON MODIFIED METHOD OF DRESSING FOR NEGATIVE-PRESSURE WOUND THERAPY

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ABSTRACT

Background: Ulcers of the lower extremities, particularly in individuals older than 65 years, are a common cause for visits to the podiatrist, or wound care specialist. The incidence of ulceration is increasing significantly due to the aging population and increased risk factors for atherosclerotic occlusion such as smoking, obesity, and diabetes. Various other wound therapies have been advocated. However, these methods are more expensive and lack sufficient scientific evidence in their favor. Negative Pressure Wound Therapy (NPWT) is a newer non-invasive adjunctive therapy system that uses controlled negative pressure, using a Vacuum-Assisted Closure (VAC) device, to help promote wound healing by removing fluid from open wounds, preparing the wound bed for closure, reducing edema, and promoting formation and perfusion of granulation tissue. This study aims to evaluate Standard VAC therapy compared with modified method of VAC therapy in the treatment of large infected ulcers in lower socio-economic patients.

Materials and Methods: This study was prospective case-control series which was conducted by the Department of Orthopaedics Khaja Bandanawaz Teaching and General Hospital which is a tertiary care hospital. Our study was conducted between July 2022 to January 2023. The study population included 60 patients with crush injuries, deglove injuries, and non-healing lower limb ulcers Wagner grade 2 or 3 admitted in our hospital. It was a randomized case-control study. The study population was ranging from 25- 60 years that included crush injuries, deglove injuries, lower limb ulcers. Patients were randomized either to group A (patients treated with standard VAC therapy) or group B (patients treated with modified method of VAC therapy), with 30 patients in each group. Dressing was kept for over a period of 2-7 weeks. Ulcers were treated until the wound closed spontaneously, surgically or until completion of the 50 days period, whichever was earlier. Treatment success was defined as wound closure within a period of 7 weeks.

Results: Granulation tissue appeared in 73 % of patients in both standard VAC group and Modified Method of VAC by the end of week 2 which further reached to 100 % by the end of week 5. Patient satisfaction was excellent in the majority of patients in both standard VAC group Modified Method of VAC group. No patient in our study reported discomfort with the application of pressures greater than 100 mm of Hg.

Conclusion: This study has confidently established that the cost of daily consumables, and thus the overall cost, can be reduced by the simple modification described, while still achieving the desired outcome.

Keywords: Negative Pressure Wound Therapy (NPWT), Vacuum-Assisted Closure (VAC) device, Wagner grading system, non-healing ulcers treatment, modified vacuum-assisted closure (VAC) therapy, cost effective dressings.

INTRODUCTION

Ulcers of the lower extremities, particularly in individuals older than 65 years, are a common cause for visits to the podiatrist, wound care specialist.^[1] The incidence of ulceration is increasing significantly due to the ageing population and increased risk factors for atherosclerotic occlusion such as smoking, obesity, and diabetes.^[2] Leg ulcers is reported to have impact on virtually every aspect of daily life: pain is common, sleep is often impaired, mobility and work capacity tend to be restricted, and personal finances are often adversely affected. It is also known that social activities are restricted due to fear of injury and negative body image. Leg ulcers is usually associated with significant morbidity, high cost of healthcare, loss of productivity, and reduced quality of life.^[3]

Wound healing is a complex and dynamic process that includes an immediate sequence of cell migration leading to repair and closure. This sequence begins with removal of debris, control of infection, clearance of inflammation, angiogenesis, deposition of granulation tissue, contraction, remodeling of the connective tissue matrix, and maturation. When wound fails to undergo this sequence of events, a chronic open wound without anatomical or functional integrity results.^[4]

Saline-moistened gauze has been the standard method; however, it has been difficult to continuously maintain a moist wound environment with these dressings. Subsequently, various hydrocolloid wound gels, growth factors, enzymatic debridement compounds, hyperbaric oxygen therapy, cultured skin substitutes, and other wound therapies have been advocated. These therapies are associated with significant expenses and are being utilized in some situations without sufficient scientific evidence in favor of their efficacy.^[5] Negative pressure wound therapy (NPWT) is a newer non-invasive adjunctive therapy system that uses controlled negative pressure, using vacuum-assisted closure (VAC) device, to help promote wound healing by removing fluid from open wounds, preparing the wound bed for closure, reducing edema, and promoting formation and perfusion of granulation tissue.^[6]

This study aims to evaluate Standard VAC therapy compared with modified method of VAC therapy in the treatment of large, infected ulcers in lower socio-economic patients.

MATERIAL AND METHODS

This study was prospective case-control series which was conducted by the Department of Orthopaedics Khaja Bandanawaz Teaching and General Hospital which is a tertiary care hospital. Our study was conducted between July 2022 to January 2023.

The study population included 60 patients with crush injuries, deglove injuries, and non-healing lower limb ulcers Wagner grade 2 or 3 admitted in our

hospital with age range between 25 to 60 years and were randomized either to group A (patients treated with standard VAC therapy) or group B (patients treated with modified method of VAC therapy), with an equal number of patients in each group.

Ulcers were graded by the Wagner system.^[7] Standard VAC dressing was kept for over a period of 2–7 weeks. Ulcers were treated until the wound closed spontaneously, surgically or until completion of the 50-day period, whichever was earlier.^[8]

After wound closure, patients were followed on a regular basis. Patients who were discharged from the hospital after wound closure were followed twice weekly, then weekly, followed-up every 2 weeks, and then monthly. Follow-up was done for up to 6 months. Treatment success was defined as wound closure within a period of 7 weeks.^[8]

The standard VAC device consisted of open-pore foam (reticulated polyurethane or polyvinyl alcohol) dressings cut to the shape of the wound and a vacuum unit providing either continuous or intermittent negative pressure.^[8]

The modified method of VAC device includes sponge (foam) dressings cut to the shape of the wound and a ryles tube connected to a normal suction machine.

A detailed history, clinical examination and relevant investigations were performed in all patients. A written informed consent was obtained from all the patients in the study.

The institutional ethical committee of our hospital gave approval for the study. All the patients with non-healing ulcers included in the study, irrespective of group assigned, underwent initial surgical debridement. Later, wounds were treated with multiple irrigations with saline and minor debridement to remove slough or necrotic tissue when needed.

Standard VAC therapy

Step 1: Preparation of wound bed

Old dressing from the wound was removed and discarded. If required, a culture swab for microbiology was taken before wound irrigation with normal saline (Fig 1). Surface slough or necrotic tissue was surgically removed (minor surgical debridement) and adequate haemostasis achieved (Fig 2). Skin around ulcer was cleaned with spirit.

Step 2: Foam placement (Fig 3)

Sterile, foam dressing was gently placed into the wound cavity to provide an even distribution of negative pressure over the entire wound bed to aid in wound healing.

Step 3: Draping

The site is then sealed with an adhesive drape. In our study, we used iodine-impregnated adhesive dressing (Ioban, 3M) which covered at least 5 to 7 cm of surrounding healthy skin to ensure effective seal. Separate drapes were used for suction tube and covered at least 7 to 10 cm of tubing forming a mesentery like covering (Fig 4).

Step 4- The application of negative pressure

Controlled pressure is uniformly applied to all tissues on the inner surface of the wound. The foam dressing should compress in response to the negative pressure. The ideal pressure setting is 125 mmHg (Fig 5), but painful chronic wounds such as chronic leg ulcers are usually managed with lower therapeutic pressures of 50 to 75 mmHg. Higher pressures of 150 mmHg plus are used for large cavity wounds such as acute traumatic wounds, as they produce copious amounts of exudate.

Dressing was changed every 48 to 72 h or sooner if the wound was infected. Care was taken when removing the adhesive drape to avoid irritating the peri-wound skin.

Modified method of VAC therapy Materials required (Fig 6)

Step 1: Preparation of wound bed

Old dressing from the wound was removed and discarded. Surface slough or necrotic tissue was surgically removed (minor surgical debridement) and adequate hemostasis achieved (Fig 7). Skin around ulcer was cleaned with spirit.

Step 2: Foam placement (Fig 8 and Fig 9)

Imprintment of the wound edges is being taken over the sponge, the sponge is cut surrounding the imprintment area. Ryles tube is being inserted in the cut area of sponge. Sterile, sponge dressing was gently placed into the wound cavity to provide an even distribution of negative pressure over the entire wound bed to aid in wound healing.

Step 3: Draping

The site is then sealed with an adhesive drape (Fig 10). In our study, we used impregnated cling adhesive drape which covered at least 5 to 7 cm of surrounding healthy skin to ensure effective seal.

Step 4: Application of negative pressure

Controlled pressure is uniformly applied to all tissues on the inner surface of the wound. The foam dressing should compress in response to the negative pressure. The pressure applied to it was 200 mm of Hg (Fig 11).

Inclusion Criteria

Wounds treated with VAC in our study included:

1. Crush injuries
2. Road traffic accidents
3. Venous ulcers
4. Diabetic foot ulcers.

Exclusion criteria

Following patients were excluded from study:

1. Patients with previous VAC therapy and those on other forms of advanced wound therapy like hyperbaric oxygen therapy, normothermic wound therapy, or growth factor therapy within 30 days of the study, start date were excluded.
2. Patients on corticosteroids, immunosuppressive agents, or chemotherapeutic agents and patients with poorly controlled medical problems were also excluded from the study.
3. Patients with malignancy in the wound, untreated osteomyelitis.
4. Wounds with exposed arteries or veins.

5. Patients on anticoagulants or with actively bleeding wounds.

RESULTS

A total of 60 patients who met the inclusion criteria were enrolled in the study. Patients were randomly assigned to either standard VAC group or Modified Method of VAC group. Patients, either in standard VAC group or Modified Method of VAC group, were matched for age, gender and grade of ulcer. After admission, patients were closely followed for signs of healing in both groups.

All patients with diabetes were closely monitored for glycemic control and routine endocrine consultations were sought in all the patients on daily basis. All patients were put on insulin for control of their blood sugars. Overall, lower doses of insulin were required to control hyperglycemia in standard VAC group as compared to Modified Method of VAC group.

In our study, the final point was taken as completely granulated wound, free of discharge or a wound ready for skin grafting or spontaneous healing by secondary intention. Good protein diet was given to both groups as per hospital policy. Age distribution of patients in standard VAC group and Modified Method of VAC was between 25 and 60 years, which included 22 males and 8 females in the standard VAC group and 18 males and 12 females in conventional VAC group (Fig12) with a total of 60 patients.

Most of the cases in our study include road traffic accidents followed by crush injuries, venous ulcers and diabetic ulcers (Fig13).

Granulation tissue appeared in 73 % of patients in both standard VAC group and Modified Method of VAC by the end of week 2 which further reached to 100 % by the end of week 5.

The average hospital stay duration was 18 days in conventional VAC group and 15 in standard VAC group (Fig 14).

Majority of the patients in VAC group were finally closed by split tissue skin grafting. STSG was done in routine theatre after ulcer was covered by granulation tissue and was devoid of discharge.

Patient satisfaction was excellent in the majority of patients in both standard VAC group Modified Method of VAC group. No patient in our study reported discomfort with the application of pressures greater than 100 mm of Hg.



Figure 1: Removal of old dressing



Figure 2: Surgical removal of slough



Figure 3: Foam placement



Figure 4: Sealing with adhesive drape



Figure 5: Application of controlled negative pressure



Figure 6: Required materials for modified VAC



Figure 7: Surgical removal of slough



Figure 8: Imprintment of the wound edges over the sterile sponge



Figure 11: Application of negative pressure



Figure 9: Sponge cut to appropriate size

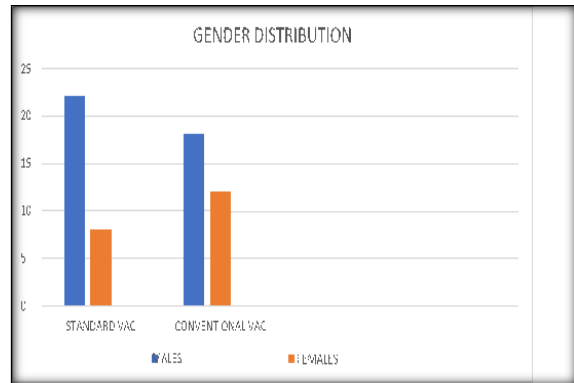


Figure 12: Age distribution of patients



Figure 10: Sealing with impregnated cling adhesive drape

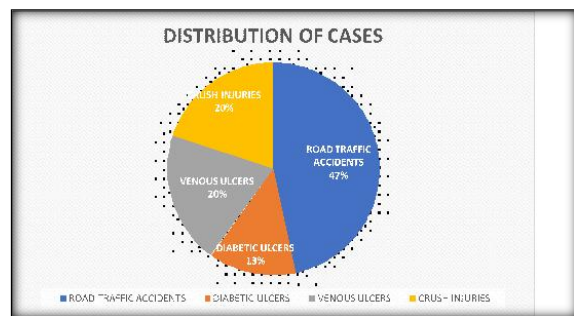


Figure 13: Etiology of ulcers in our study

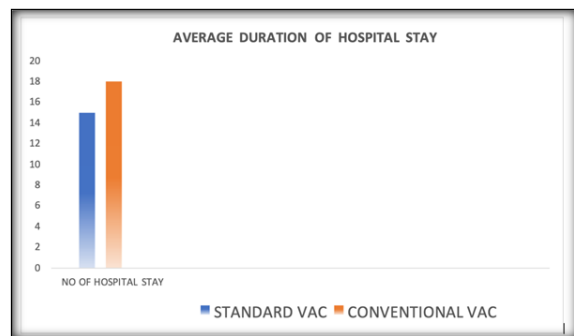


Figure 14: Average duration of hospital stay



Figure 15.1: Healthy wound being closed by STSG (front view)



Figure 15.2: Healthy wound being closed by STSG (side view)

DISCUSSION

Our study was prospective case-control series which was conducted Department of Orthopaedics Khaja Bandanawaz University faculty of medical sciences which is a tertiary care hospital.

The ability of regular VAC dressings to promote wound bed granulation and healing has been demonstrated in several studies. Application of VAC over the ulcer allows the arterioles to dilate, increasing local circulation, promoting angiogenesis, reduces bacterial burden and chronic interstitial wound fluid which finally leads to increased granulation tissue over the wound⁶. Wound bed optimization is crucial in preventing ulcer complications and favors eventual wound closure either by split-tissue skin grafting or by secondary intention.

Based on the results of the statistical analysis, it can be clearly shown that demographic parameters, such as age and gender, as well as medically-related parameters, such as wound site, size, cause of the wound, and presence of comorbidities and chronic diseases, do not statistically contribute to differentiation between the two groups.

The majority of wounds in our patients were closed by a split-thickness skin graft in both groups (Fig 15.1 & 15.2). Our study is comparable to study

conducted by Argenta LC et al. in their study of 296 wounds majority responded favorably to VAC treatment.⁹ Majority of patients needed STSG for coverage after the wound was free from discharge and had good granulation tissue coverage the authors concluded that VAC is an extremely efficacious modality for treating chronic and difficult to heal wounds.

The cost value of treatment was Rs 8000/- (96.34 United States Dollars) in the standard group and Rs. 3000/- (36.13 United States Dollars) in the modified group, which clearly indicates the significant improvement in overall cost between the two groups. Based on the above evidence, this study can conclude, without a doubt, that it is possible to use the modified VAC Therapy System for crush injuries, deglove injuries, and lower limb ulcers while effectively minimizing the daily consumable costs associated with using it.

CONCLUSION

The use of NPWT is an integral part of the therapeutic advancement and optimal management of different wounds, aiding overall healing and accelerating wound closure. Multiple previous studies have established the efficacy of the VAC system as a type of NPWT. The high cost related to its use has been discussed in previous studies, with alternative methods and modifications identified in an attempt to lower the associated costs. This study has confidently established that the cost of daily consumables, and thus the overall cost, can be reduced by the simple modification described, while still achieving the desired outcome. In addition, this method is economically feasible and can easily be adopted by other centers, especially in countries that lack the financial support to acquire standard VAC materials or where they are simply unavailable. In conclusion, this method has shown considerable evidence and could be an acceptable alternative for other centers aiming to reduce the overall cost while using the modified VAC system.

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