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A Study of Wound Healing with Modified Topical Negative Pressure Therapy in Chronic Wounds

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Abstract: ***Background: Wounds are a major source of morbidity even lead to considerable disability and are associated with increased mortality; hence it implies a significant impact on public health and the expenditure of healthcare resources. Negative pressure wound therapy (NPWT) has transformed the management completely for chronic wounds. However, it's availability at every center and high cost of a conventional NPWT system still an enigmatic challenge. We carried out this study to assess whether we can replicate the conventional NPWT system using resources which are easily available in most hospitals and determine its clinical efficacy and cost effectiveness. Material and Method: A total of 30 cases clinically presenting as ulcer between August 2019 and February 2021 were taken for study. Each patient was examined clinically in systematic manner for study presenting with wound. Modified VAC dressing was done and outcome was measured by recording wound scores on days 3, 7 and 10. Result: The study group included 20 males and 10 females. Duration of stay in hospital ranged from 5 to 34 days, with average duration of 11.93 days. Wound closure was achieved by secondary suturing in 12 (40%) of the cases and split thickness skin grafting in 14 (46.66%) of the cases while 4 patients lost to follow up. Wound assessment was done using the wound scoring system which revealed most of the wounds attaining granulation tissue 66% of patients by day 5 post vac therapy. Wound healing was better in the non-diabetic group compared to diabetic and in non-smokers compared to smokers.***

Keywords: VAC, Vacuum Assisted Closure, NPWT, Negative Pressure Wound Therapy

1. Introduction

Wounds possess a major public health problem and it is of great importance all over the globe since it contributes significantly to morbidity and long-term disabilities. It is a stressful disease to those affected as well as to their family and the community in general, and its impact on hospital resources is great due to prolonged hospitalization, high cost of health care, loss of productivity and reduced quality of life.

Negative pressure wound therapy (NPWT) also referred as vacuum assisted closure (VAC) has brought a paradigm shift in the management of wounds in last 28 years. This technique was first described by Fleischmann et al., in 1993 (1). It is defined as a systematic dressing of wound in which intermittently or continuously sub-atmospheric pressure is applied on wound surface in order to enhance the granulation tissue by removing debris or serous discharge from the site. NPWT is the new arm and turned to be a cornerstone in management of chronic wounds, allowing them much easier wound care, particularly for the wounds in which dressing frequently is a problem. The conventional NPWT equipment with specialised foam and suction machine with container along with trained personnel for its application makes the overall cost of therapy very high. Hence, the surgeon's responsibility increases with the aim to achieve wound healing in the shortest time possible with no or minimum complications, using the most cost-effective method and few authors have also published their studies to minimise the cost of vac therapy.

The purpose of the study I had pursued is to find out the effect of Negative Pressure Wound Therapy dressing in detail and its outcome on wound surface area reduction and at a lower cost using materials which are readily available.

2. Materials and Methods

A prospective study was carried out in department of General Surgery at MMIMSR, Mullana, Ambala from August 2019 to February 2021. After obtaining clearance from the Institutional Ethical Committee, a total of 30 patients were included in the study fulfilling the inclusion criteria which includes patient with diabetic ulcers, venous ulcers, traumatic ulcers and pressure sore above 18 years of age while patients with atypical mycobacterium, untreated diabetes mellitus and known case of malignancies.

Procedure
Any of the dressings on the wound site were removed and discarded simultaneously, following which a swab for culture and sensitivity of wound was taken. Surgical debridement was done extensively removing slough, necrotic tissue and pus from the surface of wound until adequate hemostasis achieved.

A thorough wound lavage is done to remove bacterial colonization and dead and necrotic tissue.

Placement of foam:
The polyurethane foam of 200mm thickness is cut according to the size and shape of the wound and is placed on the wound.

Insertion of draining tube
A draining tube (Ryle Tube no 16) is embedded in the foam which is connected to a central suction on the other end.

Sealing with drapes:
The wound site is then sealed with an adhesive transparent sheet (Ioban 5560 sheet) such that it covers the foam completely. The adhesive membrane covers the foam and the suction tube properly to avoid any leak in the dressing.

Application of negative pressure:
Using centralized vacuum controlled negative pressure of 125mmhg was applied continuously for 72 hours. The foam dressing compressed in response to the negative pressure signifies that there is no leak.

Removing of dressing
The adhesive tape was removed gently to avoid irritation of surrounding skin and the foam was removed by pouring normal saline and makes it easy and less damage to the underlying granulation tissue.

The outcome was measured in terms of area of wound covered with granulation tissue based upon wound scoring system.

3. Results

A total of 30 patients satisfying the inclusion and exclusion criteria aged between 34 to 67 years were included. There were 20 (67%) males and 10 (33%) female patients. Duration of stay in hospital ranged from 5 to 34 days, with average duration of 11.93 days. In our study of Modified NPWT, scoring of wounds was done from 1-7 scores based upon granulation tissue area in all cases.

Those patients whom socres are >5 following the NPWT dressing are considered for SSG and in our study it is >80% which showed a score of equal to or more than 5 in which 66% of patients by day 5 and 90% after day 7 post vac therapy attained granulation tissue having a score equal to or more than 5.

It has been observed during the period of the study that keeping the atmospheric pressure of 125mmhg through central suction has accelerated the wound healing andreduction in depth of wound and necrotic tissue ultimately led to faster wound healing. 57% of cases were smokers and 30% of cases were diabetic showed scores equal to or more than 5 on or beyond day 7 of VAC dressing, hence the healing is at a slow rate in diabetics and smoker's despite of the NPWT. While the cases who were nonsmokers, not diabetic or with the traumatic wounds are benefited from VAC therapy with faster rate of healing in terms of granulation tissue formation. Venous ulcers showed better results when VAC was done along with other modalities of treatment like limb elevation.

Wound closure was achieved by secondary suturing in 12 (40%) of the cases and split thickness skin grafting in 14 (46.66%) of the cases while 4 patients lost to follow up.

Since we used all locally available resources, we could significantly reduce the cost of therapy with such modifications and better results in shortest possible time.

4. Discussion

Delay in healing of wound is a significant health problem and an effortful task in the community setting particularly for old age patients because of almost daily or very frequent visit to the hospital for wound dressing. With the conventional methods involved in wound-healing, it might take several months to heal the wound. Keeping the sufferings and pain in consideration while going through the process of wound healing, failure to heal results in social and financial burden.

Thousand years ago, the Chinese were applying cups that contained heated air to wounds and when the air inside those cups cooled, it has been observed that there is slight reduction in pressure.

Raffel (1852); Silvis et al (1855)(2,3) was the first to demonstrate the use of NPWT for the first time in early 1800s to manage exudate and to accelerate the process of wound healing.

Fleishchmann et a1 (1893)(4) conducted the first ever studies into NPWT using foam as a wound contact layer. It has been done over 14 patients who had open fractures and were treated in this manner their description is given in German. No patient reported with infections in this group and an apparent there was increase in granulation tissue formation.

The Sub atmospheric pressure of vac therapy causes wound healing by secondary or tertiary intention by the following methods:

1) Dissipating the oedema from the wound and extracting via suction,
2) Formation of early granulation tissue and extracellular matrix,
3) Increasing the blood supply to the wound by angiogenesis,
4) Removing harmful infectious material and enzymes from the wound bed,
5) By causing constructive mechanical effects on the cells.
   a) Macro-strain is the centripetal force acts on the wound bed which draws the wound edges together.
   b) Micro-strain is the microscopic effect of vacuum on wound led to Stretching of cells, increased perfusion of tissues and continuous cell division leading to proliferation of fibroblasts.

All these create an environment for healing of wound at cellular level of the wound.

Even after so much widespread of VAC dressing into the clinical practice, the exact mechanics and its effects are still a misnomer completely and which has led to many proposed theories for it. VAC dressing increases the local blood flow to wound causing reduction in edema and decrease bacterial counts. It enhances the process of formation of granulation tissue so that the definitive procedure can be carried out in shortest possible time.

VAC therapy has emerged as an alternative to routine wound management, which involves negative pressure for optimization of the conditions for wound healing and also significant reduction in process of painful dressing (5). VAC seems to have a promising future in managing wounds and will be effectively treating all sorts of wounds as surgeon desires in the utmost faith of the patient and relative. So, that wound will not be a cumbersome for the society by

significantly reducing the cost to health care for both patient and hospital in order to enhance the quality of life.

NPWT is considered as an entailing great expense modality as per a recent report; hence the use of it as a first-line therapy isn't suitable. While we believe with certain modifications in the VAC therapy as done in our study has the advantages in terms of finances as well as better outcome in shortest possible time if used on "Right patient on Right wound and at the right time."

Hamidreza et al(6) and **Gopal et al**(7) in 2016 and 2018 respectively did a study on NPWT using sterile materials and had a drastic reduction in terms of cost and hospital stay with faster wound healing thus benefitting the patient in every aspect but the drawback being could only be done for a smaller sized wound.

VAC therapy has wide range of benefits it can be applied to most of the wounds but all wounds cannot be treated by VAC therapy. VAC causes bone exposed wound to be covered by granulation tissue which requires a simple split skin graft to cover the granulation tissue as when compared with the conventional dressing the bone exposed area is more time consuming and needs more expertise flap cover for covering the wound.

It has been observed during the period of the study that keeping the atmospheric pressure of 125mmhg through central suction has accelerated the wound healing ultimately led to significantly increase in success rate of skin graft. VAC is usually very well tolerated and is having very few contraindications or complications. Thus, is becoming a mainstay of current wound care.(8)

In our study we have used modified negative pressure dressings, using an autoclavable sponge, Ryle's tube, transparent adhesive dressing film and centralised suction system. NPWT dressings were applied after thorough debridement and a pressure of 100-125 mm Hg was maintained. Most of the literature recommends 125 mm Hg as the standard suction pressure to be used with VAC systems. However lower suction pressures have been advocated if application of suction causes pain or bleeding from the wound. The pressure can be then increased in a stepwise fashion. (9)

The sponge can be sterilized by autoclaving and we could significantly reduce the cost of dressing material by using the sponge which was available free of cost to us through medical central service store. We also used centralised suction to create negative pressure environment. The only recurring expenditure was that of the semi permeable adhesive material and Ryle's tube. Thus, the cost was extremely low as compared to the conventional NPWT dressings. Although we have got very good results using this technique, our study has a few limitations. The study is non randomized.

Our sample size is small and the mean follow up period is short, maintaining continuous negative pressure through central suction was challenging. Foam contact to the wound to create a perfect seal was difficult. However, the results have been pretty encouraging and use of this technique in a larger patient group is required to validate our results.

5. Conclusion

VAC Dressing is a new modality for the management of wounds. After its introduction the course of management of wound has changed. It can be concluded based upon the observation during the study and the data available that VAC results in better healing, faster granulation tissue rates, very few complications, short span of time and thus looks to be promising tool in future for the management of wounds.

Through our study we describe a simple and effective method of application of negative pressure dressings which may be beneficial in low resource settings where standard equipment's are not available and the patients are not able to afford the cost of conventional negative pressure wound therapy. Our method is easily reproducible, cost effective and does not require special expertise for its application.

References

[1] Fleischmann W, Strecker W, Bombelli M, Kinzl L. Vacuum sealing as treatment of soft tissue damage in open fractures. Unfallchirurg. 1993;96:488-492.
[2] Raffel, A.B. (1952). The use of Negative Pressure under skin flaps after radical mastectomy. Ann.Surg. 136: 1048. Page no.27
[3] Silvis, R.S., Potter, L.E., Robinson, D.W., Hughes, W.F. (1955). The use of continuous suction negative pressure instead of pressure dressing. Ann Surg. 142(2): 252-6. Page no.27
[4] Feleischmann W, Strecker W, Bombelli M Kinzl L. Vacuum sealing as treatment of soft tissue damage in open fractures. Unfallchirug 1993; 96 (9) : 488-92. Page no.29 S. M. Jones, P. E. Banwell, and P. G. Shakespeare, "Advances in wound"
[5] Bora K, Shahapukar VV, Agrawal M and Sharma A. Early debridement and skin grafting in diabetic ulcer to reduce morbidity. International Journal of Biomedical and Advance Research.2014:5;44-4 6.
[6] Arti H, Khorami M, Ebrahimi-Nejad V. Comparison of negative pressure wound therapy (NPWT) &conventional wound dressings in the open fracture wounds. *Pak J Med Sci*. 2016;32(1):65-69.
[7] Gopal SV, Solomon A. An inexpensive method of negative pressure wound therapy for extremities. Int Wound J. 2018;1–3.
[8] T. E. Philbeck, K. T. Whittington, M. H. Millsap, R. B. Briones, D. G. Wight, and W. J. Schroeder, "The clinical and cost effectiveness of externally applied negative pressure wound therapy in the treatment of wounds in home healthcare Medicare patients," Ostomy/Wound Management, vol. 45, no. 11, pp. 41–50, 1999. Page no.113
[9] Robert N. Negative pressure wound therapy in orthopaedic surgery. OrthopTraumatol Surg Res. 2017;103(1S):S99eS103.

Figure 1: Traumatic Ulcer Post Debridement

Figure 2: Ulcer Post VAC Therapy

Figure 3: Depicitng the Applied VAC Dressing

Figure 4: Central Suction Apparatus for Vaccum Dressing

Figure 5: Sterile Sponge