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Vacuum - assisted closure (VAC) dressing therapy for the management of wounds: Our experience in rural set up

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Abstract: *Introduction:* Vacuum-Assisted Closure (VAC) uses negative pressure to assist wound healing. Negative pressure drains fluid from the wound, thus removing the substrate for growth of microorganisms. Negative pressure may also accelerate granulation tissue formation and promote angiogenesis. The mechanical stimulation of cells by tensile forces may also play a role by increasing cellular proliferation and protein synthesis. Negative Pressure Wound Therapy (NPWT) involves the use of a negative pressure therapy or suction device to aspirate and remove fluids, debris and infectious materials from the wound bed to promote the formation of granulation tissue. *Material and Methods:* A total o 25 cases of ulcers between August 2019 and June 2020 were taken for study. Out of 25 patients 18 were males and 7were females, Mean age ranging from 22 to 70 for males and 18 to 57 for females. In our study, maximum cases reported were diabetic ulcers 19 (76%), road traffic accidents 4 (16%) patients and 2 (8%) patients had mechanical injury. *Results:* Out of 25 wounds in the study, 20 wounds reduced in area and cured with split thickness skin grafting and 5 wounds were reduced in area and healed after secondary suturing. All wounds were infected before VAC treatment. After VAC dressing, almost all wounds became swab negative, no patient required surgical debridement and there was gradual decrease in size of wound. Wound healing was better in the controlled diabetic group compared to uncontrolled diabetic group. Commonest organisms isolated were Staphylococcus, Pseudomonas and Proteus. *Conclusion:* VAC dressing provides sterile and controlled environment to large wound surfaces by controlled application of sub-atmospheric pressure and prepares wounds for closure through split skin grafting and secondary closure in short time leading to less overall morbidity with decreased hospital stay. In our study, VAC therapy promotes granulation tissue formation leading to faster wound healing and speedy recovery. VAC is promising technique in wound healing. It can be used in all types of wound.

Keywords: Non Healing Wound, Negative Pressure Wound Therapy (NPWT), Vacuum Assisted Closure (VAC).

Introduction

Wounds are a major cause of morbidity, disability, burden in terms of economy and time on healthcare system. Vacuum-Assisted Closure (VAC) uses negative pressure to assist wound healing. Negative pressure drains fluid from the wound, thus removing the substrate for growth of microorganisms. Negative pressure may also accelerate granulation tissue formation and promote angiogenesis. The mechanical stimulation of cells by tensile forces may also play a role by increasing cellular proliferation and protein synthesis. Negative Pressure Wound Therapy (NPWT) involves the use of a negative pressure therapy or suction device to aspirate and remove fluids, debris and infectious materials from the wound bed to promote the formation of granulation tissue [1].

When wound fails to undergo this sequence of events, a chronic open wound without anatomical or functional integrity results [2]. Standard treatment of wound healing includes debridement of necrotic tissue, hydrocolloid wound gels, dressings with enzymatic debridement compounds, local ulcer care, infection control, management of blood glucose levels etc. The treatment of chronic, open wounds is costly, requires long hospital stay. Faster healing of chronic wounds could result in decreased hospitalization and an earlier return of function.

Vacuum assisted closure (VAC) dressing therapy, may also be known as negative pressure wound therapy (NPWT) or Micro deformational wound therapy, which has brought a revolution in wound care since past 20 years. This method was first described by Fleischmann *et al*. in 1993 [3]. VAC dressing therapy is a non-invasive therapy. It is a Therapeutic technique using a vacuum dressing to promote healing in acute or chronic (non healing wounds, traumatic wounds). It involves controlled application of sub-atmospheric pressure to local wound environment, using a sealed wound dressing connected to a vacuum pump.

It uses vacuum assisted drainage to remove blood or serous fluid from operative site. It promotes dry surgical field & control blood flow. It reduces infection rates; increasing localized blood flow. It also supplies wound with oxygen & nutrition to promote healing. Initially developed in the early 1990s, for the management of large, chronically infected wounds that could not be closed in extremely debilitated patients, the use of vacuum-assisted closure (VAC) dressing therapy has been more recently used in the treatment of non-healing and traumatic wounds [4].

Material and Methods

All patients were above 18 years of age of both sexes. Out of 25 patients 18 male and 7 females, mean age ranging from 22 to 70 for males and 18 to 57 for females. In our study, maximum cases were of diabetic ulcers 19 (76%) patients, followed by road traffic accident 4 (16%) and 2 (8%) patients had mechanical trauma.Vacuum Assisted Closure (VAC) dressing therapy applied for all these wounds.

*Inclusion Criterion:*All chronic wound patients came to surgical out patient department.

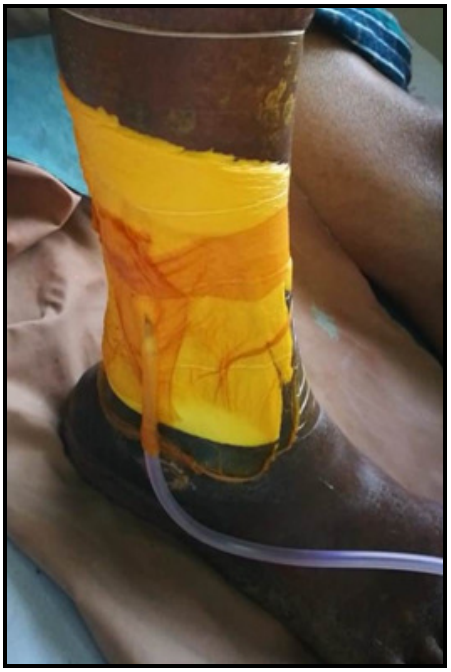
Materials Required:

- Autoclaved sponge foam
- Ioban
- Suction apparatus, portable electrical suction machine
- Suction catheter/Ryle's tube
- Transperent adhesive tape

The VAC Procedure: Swab from wound taken after removing dressings. Wound was cleaned and slough was surgically removed. Wound and periphery was prepared and draped. Autoclaved Sponge foam which is normally available at hardware stores of was taken and is cut in to shape of the wound with slightly larger size than the wound. A suction catheter/Ryle's tube with adequate number of fenestrations made depending upon the wound size is placed in between the two sponge layers and the whole wound area is sealed with Ioban sheet. Sheet covers the foam and tubing and five centimeters of surrounding healthy tissue to ensure a proper seal.

The suction catheter was connected to vacuum apparatus. The negative pressure applied will be from −100 mm Hg to−200 mm Hg. VAC dressings were changed at intervals of 3-4 days depending upon the debris and fluid drained, leakage from the sealed area, blockage of tube and state of the wound. The VAC dressing therapy were done till the granulation tissue covers the wound and then repaired by skin graft or secondary suturing.

Fig-1: VAC Dressing



Results

Out of 25 wounds taken in the study, 20 wounds reduced in area with healthy granulation tissue and cured with split thickness skin grafting and 5 wounds showed

reduction in area & were subjected to secondary suturing. Before VAC therapy, all wounds were infected. After VAC therapy, almost all wounds became swab negative during course of VAC therapy, no patient required surgical debridement and there was gradual decrease in size of wound.

Table-1: Distribution of patients according to Age, Sex and Mode of Injury	
Number of patients	**25**
Sex	Male 18 (72%)
	Female 7 (28%)
Average age	22 to 70
	18 to 57
Cause of wound	Diabetes
	Road Traffic Accident
	Trauma

Table-2: Bacterial growth on first and seventh days		
Bacterial growth	**Number of VAC patients =25**	
	Day 0	**Day 7**
Present	25(100%)	1(4%)
Absent	0	23(92%)

Discussion

Delayed wound healing is a significant health and community problem, especially in diabetic patients. It is economic and time burden on society with longer hospital stays. Conventional wound-healing methods may take several months to heal the wound. Vacuum-Assisted Closure (VAC) therapy has been developed as an alternative to the standard forms of wound management, which incorporates the use of negative pressure to optimise conditions for wound healing and requires fewer painful dressing changes[5].Wound healing is complex interactions between cells, the cellular microenvironment and extra cellular matrix molecules that usually results in a functional restoration of the injured tissue [6-7].

Locally acting growth factors influence healing in the events of migration of neutrophils, proliferation, angiogenesis, formation of extra cellular matrix, macrophages, fibroblasts, increasing collagen and protein production thereby enhancing the healing of wound [8-9]. Disruption of any of these factors may adversely affect the healing process, resulting in a chronic or non-healing wound. Application of subatmospheric pressure decreases the bacterial colonization over the wound and increases the blood flow [10].VAC is said to reduce oedema and thought to promote closure of the wound by promoting the rapid formation of granulation tissue as well as by mechanical and removes excess wound exudates, thus aiding in the creation of the "ideal wound healing environment."[11]. Increased oxygenated blood flow to the wound healing promotes the oxidative bursts in neutrophils and there by promoting the killing of microbes and preventing infection [12].

Our study showed that in VAC dressing therapy after seventh day , there were 92% of patients who had no bacterial growth. There have been similar studies by Morykwas and Argenta, Banwell*et al*, [13] and Morykwas*et al* [14]. Which showed clearance of bacteria from infected wounds using VAC dressing therapy. Weed *et al*. while quantifying bacterial bio burden during negative pressure wound therapy concluded with serial quantitative cultures that there is no consistent bacterial clearance with the VAC dressing therapy, and the bacterial growth remained in the range of 10^5-10^6[15].Thomas first postulated that application of mechanical stress would result in angiogenesis and tissue growth. Unlike sutures or tension devices, the VAC dressing therapy can exert a uniform force at each individual point on the edge of the wound drawing it toward the center of the defect by mechanically stretching the cells when negative pressure is applied [16].

The use of subatmospheric pressure dressings has been shown to be an effective way to accelerate healing of various wounds. The optimal subatmospheric pressure for wound healing appears to be approximately 125 mmHg. VAC has significantly increased the skin graft success rate when used as a bolster over the freshly skin-grafted wound. VAC is generally well tolerated and with few contraindications or complications is fast becoming a mainstay of current wound care [17].

Diabetes mellitus is recognised as a risk factor for compromised wound healing. These data suggest that delayed healing in diabetes is associated with altered leukocyte infiltration and wound fluid IL-6 levels during the late inflammatory phase of wound healing [18]. An increased incidence of wound complications in surgical patients with diabetes mellitus may actually reflect the increased incidence of general surgical risks or metabolic abnormalities associated with diabetes mellitus. Factors such as age, obesity, malnutrition and macrovascular and microvascular disease may contribute to wound infection and delayed wound healing, especially in the type II diabetic patient [19].

Our study showed that VAC dressing therapy increases the vascularity and rate of granulation tissue formation compared to standard wound dressing therapy. In diabetic patients, controlled sugar levels show better results than uncontrolled diabetics. For different types of wounds, there is different amount pressure protocols and the duration of treatment changes. For chronic wounds they benefit more by continuous VAC dressing therapy. Short and intermittent VAC dressing therapy shows improved tissue response than compared to the continuous effect, but it may not be applicable for all types of cases. Intermittent VAC dressing pressure may not be tolerated by some patients due to discomfort. The optimal pressure to be applied for improvement of the wound is not yet currently known, there are different studies with application from −75 mm Hg to −150 mm Hg pressure and achieved good healing responses. Frequent change of vacuum dressings may be required for wounds with increased risk of infection. Finally VAC therapy is definitely a promising modality of dressing and proven beneficial in different varieties of diabetic wounds and enhances wound healing and faster recovery [20].

Conclusion

VAC dressing therapy provides sterile and controlled environment to large, non healing wound surfaces by controlled application of sub-atmospheric pressure. VAC results in accelerated rate of healthy granulation tissue formation and decrease in tissue bacterial levels. VAC dressing prepares wounds for closure through split skin grafting and secondary closure in short time leading to less overall morbidity with decreased hospital stay. Inour study Vacuum assisted closure (VAC) dressing therapy appears to be beneficial for the treatment of non-healing wounds and traumatic wounds. More studies with larger sample size are required to assess the use and cost-effectiveness of VAC therapy on different wound types.

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