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Research Article

Role of vacuum assisted closure therapy in chronic wounds: for some cases in Navi Mumbai

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ABSTRACT

Background: This study was performed to evaluate the results of vacuum assisted wound therapy in patients with chronic non healing ulcer.
Methods: The study was conducted in the department of General Surgery at a tertiary care hospital. It was an observational study with prospective design. The role of NPWT in various wounds was studied in 10 patients.
Results: Out of 10 wounds taken in the study, 7 wounds reduced in area & were resurfaced with Split thickness skin grafting and 3 wounds showed reduction in area & were subjected to secondary closure.
Conclusions: Vacuum assisted closure (VAC) therapy provides sterile and controlled environment to large, exudating wound surfaces and is treatment of choice in infected / non – healing wounds, not responding to standard treatment.

Keywords: VAC Therapy, Chronic non healing ulcer, Ulcer, NPWT

INTRODUCTION

Delayed wound healing is significant health problem in India. In addition to pain and suffering, Failure of wound to heal – imposes Social & financial burdens. 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, remodelling of the connective tissue matrix, and maturation. Standard treatment includes debridement of necrotic tissue; dressings with enzymatic debridement compounds, hydrocolloid wound gels etc; infection control, local ulcer care, mechanical off-loading, management of blood glucose levels, education on foot care, hyperbaric oxygen therapy. When wound fails to undergo this sequence of events, a chronic open wound without anatomical or functional integrity results.[1] In such injuries, debridement of all nonviable tissue can produce significant soft-tissue defects precluding healing through primary closures, delayed primary closures, or secondary intention.[2] Various surgical methods have been developed to obtain coverage in these difficult situations. These include skin grafts, local rotation flaps, and myocutaneous or fasciocutaneous tissue transfers. Although skin grafts are readily obtainable, they are dependent on the vascularity of its recipient bed and may be contraindicated when exposed bone, cartilage, tendons, or surgical implants exist.[3] In such situation, a local rotation flap may be needed. When the soft tissue defect prevents local coverage,[4] free tissue transfers are usually required, but the transfer may produce donor site morbidity and require late revisions due to the size of the muscle flap.[5]

Although nonoperative modalities, such as hyperbaric oxygen, have been used to enhance wound coverage, these devices may not be available to all patients and may not be adequate for use in patients presenting with high-energy injuries due to edema, retraction of the skin and soft tissue, wound size, or loss of available local coverage.[6] Attempts have been made to identify an alternative treatment of wound management in these patients.

Clinically, chronic wounds may be associated with pressure sore, trauma, venous insufficiency, diabetes, vascular disease, or prolonged immobilization. The treatment of chronic, open wounds is variable and costly, demanding lengthy hospital stays or specialized home care requiring skilled nursing and costly supplies. Rapid healing of chronic wounds could result in decreased hospitalization and an earlier return of function. A method that improves the healing process could greatly decrease the risk of infection, amputation, and length of hospital stay and result in an estimated potential annual savings of billions of rupees of healthcare cost.[1] If Ulcers do not adequately heal with Standard Treatment, additional modalities may be required, known as Advanced Wound Care Therapies (AWCT)/Negative Pressure Wound Therapy; also known as Vacuum Assisted Closure (VAC). VAC Therapy is a Non-Invasive therapy. It is a Therapeutic technique using a vacuum dressing to promote healing in Acute or Chronic and enhance healing of First & Second Degree Burns. 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 localised 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) has been more recently used in the treatment of traumatic wounds.[7] The purpose of this study the outcome and efficacy of Negative Pressure Wound Therapy in cases not responding to standard treatment. To assess whether the management of non healing wounds / traumatic wounds using VAC therapy will result in improved efficacy and safety outcomes compared with conventional methods.

METHODS

The study was conducted in the department of General Surgery at a tertiary care hospital. It was an observational study with prospective design. The role of NPWT in various wounds was studied in 10 patients (6 males and 4 females) with a mean age of 21-65 years treated from Oct, 2014 to June, 2015. Cases included-chronic ulcers / non-healing ulcers / diabetic ulcers / traumatic wounds. Cases excluded were malignant wounds, untreated osteomyelitis, fistula to organs or body cavities, presence of necrotic tissue, patients with hemorrhagic disorders. Pressure of 125 mm of Hg was applied in 7 wounds and 75 mm of Hg in remaining 3. Pressure was continuous in 8 cases and intermittent in 2 cases. Frequency of dressing change varied from 24 to 96 hours. Duration of administration of VAC-3 to 5 weeks.

Procedure involves wound preparation, placement of foam- white foam (PVA - Polyvinyl alcohol) & black foam (PU – Polyurethane ether); sealing with drapes and application of negative pressure: Continuous or intermittent (50 – 125 mmHg); intermittent delivery – 7 min. cycle (2 min. off & 5 min. On); ideal pressure – 125 mmHg; low pressure (50-75 mmHg) -painful ch. wounds; high pressure (150 mmHg) -large wounds (traumatic etc.) Our modification of NPWT is followed in cases which are non- affording. Materials of our modification consists of sponge foam (autoclaved twice at 250°F); 18 fr ryle's tube; opsite or similar material; Gelonet / Bactigras.

RESULTS

Average Chronicity of wounds before starting the study 7 days to 3 months. During start of VAC therapy, all wounds were infected. At the end of VAC therapy, all wounds became swab negative during course of VAC therapy, no patient required surgical debridement and there was gradual decrease in size of wound. Out of 10 wounds taken in the study, 7 wounds reduced in area & were resurfaced with split thickness skin grafting and 3 wounds showed reduction in area & were subjected to secondary closure.

Mean patient age was years (range, 21 to 65 years). All patients had suffered an acute trauma. Road traffic accident was found to be most common cause with 22 (73.33%) patients, followed by machinery injury in 5 (16.66%) patients and 3 (10%) patients had a fall from height. According to Gustilo Anderson classification, out of 30 patients, 16 patients had grade IIIb injury, 7 had grade IIIc injury, 3 had IIIa injury, and 4 had grade II injury.

Decrease in wound size. There was significant decrease in wound size from day zero to day eight in VAC group in comparison to saline-wet-to-moist group as shown in Table 1.

Table 1: Size of the wound.

Measurement (mm)	VAC
1-4.9	4
5-9.9	1
10-14.9	4
15-19.9	3
20-24.9	1
>25	2

Table 2: Bacterial growth on various days.

Bacterial Growth	VAC Patients n=15		
	Day 0	Day 4	Day 8
Present	15(100%)	12(80%)	6(40%)
Absent	0	3(20%)	9(60%)

Bacterial Growth: There was significant decrease in the bacterial growth in the VAC patients (Table 2).

Figure 1: A case of traumatic ulcer. (A) Shows the wound after debridement; (B) shows the wound after 1st VAC Dressing; (C) shows the wound after 2nd VAC dressing.

DISCUSSION

Healing is an intricate, interdependent process that involves complex interactions between cells, the cellular microenvironment, biochemical mediators, and extracellular matrix molecules that usually results in a functional restoration of the injured tissue.[8,9] The goals of wound healing are to minimize blood loss, replace any defect with new tissue (granulation tissue followed by scar tissue), and restore an intact epithelial barrier as rapidly as possible. The rate of wound healing is limited by the available vascular supply and the rate of formation of new capillaries and matrix molecules.[10] These events are heavily influenced by locally acting growth factors that affect various processes including proliferation, angiogenesis, chemotaxis and migration, gene expression, proteinases, and protein production.[8,11–13] Disruption of any of these factors may adversely affect the healing process, resulting in a chronic or nonhealing wound.

Blood flow increases and bacterial colonization of wound tissues decreases following the application of subatmospheric pressure to wounds.[7] Any increase in circulation and oxygenation to compromised or damaged tissue enhances the resistance to infection.[14] Successful, spontaneous healing and healing following surgical intervention are correlated with tissue bacterial counts of less than 10^5 organisms per gram of tissue.[15] Higher levels uniformly interfere in wound healing. Increase in local tissue oxygen levels reduce or eliminate the growth of anaerobic organisms, which have been correlated to decreased healing rates.[16,17] Additionally, the increased flow should make greater amounts of oxygen available to neutrophils for the oxidative bursts that kill bacteria.[18] Our study showed that in VAC group after day 4, there were 20% of patients who had no bacterial growth, and on day 8 there were 60% of patients who had no bacterial growth, whereas in saline-wet-to-moist patients only 20% of patients had no bacterial growth on the 8th day (Figure 1). There have been similar studies by Morykwas and Argenta,[7] Banwell et al,[19] and Morykwas et al.[20] which showed clearance of bacteria from infected wounds using VAC therapy. On the other hand, Weed et al. while quantifying bacterial bioburden during negative pressure wound therapy concluded with serial quantitative cultures that there is no consistent bacterial clearance with the VAC therapy, and the bacterial growth remained in the range of 10^4–10^6.[21]

Thomas first postulated that application of mechanical stress would result in angiogenesis and tissue growth. Unlike sutures or tension devices, the VAC can exert a uniform force at each individual point on the edge of the wound drawing it toward the centre of the defect by mechanically stretching the cells when negative pressure is applied.[22] This allows the VAC to move distensible soft tissue, similar to expanders, towards the centre of the wound, thereby decreasing the actual size of the wound.[23] Our study showed a decrease in size of 1 to 4.9 mm in 26.66% of patients in VAC group whereas 93.33% in control group from day 0 to day 8. A decrease in size of 10 to 19.9 mm was seen in 46.66% of patients of VAC group and only 6.66% in control group. A decrease in size of more than 25 mm was seen in 13.33% in VAC

group. There have been similar studies by Joseph et al,[1] Morykwas and Argenta[7], and Morykwas et al.[20] which showed that VAC proved effective in shrinking the widths of wound over time compared to standard wound dressings.

Our study showed that VAC increases the vascularity and the increase in rate of granulation tissue formation compared to standard wound dressing. Histologically, VAC patients showed angiogenesis and healthy tissue growth as compared to the inflammation and fibrosis seen in standard wound dressing. Inflammation had increased in those treated with standard wound therapy and decreased in those patients treated with VAC. The highly significant increase in the rate of granulation tissue formation of subatmospheric pressure-treated wound is postulated to be due to transmission of the uniformly applied force to the tissues on the periphery of the wound. These forces both recruit tissues through viscoelastic flow and promote granulation tissue formation. Currently, the Ilizarov technique and soft tissue expanders both apply mechanical stress to tissues to increase mitotic rates.[24,25] Standard wound dressings adhere to devitalized tissue and within four to six hours the gauze can be removed, along with the tissue, as a form of mechanical debridement. This method of wound care has been criticized for removing viable tissue as well as nonviable tissue and being traumatic to granulation tissue and to new epithelial cells.[26]

There is very little literature available especially on compound injuries using VAC. Open musculoskeletal injuries have very high incidences of nonunion and infection;[27] they require urgent irrigation and debridement. As wounds are frequently left open and require repeated debridement, resulting in large soft tissue defects, early coverage of exposed bone, tendons, and neurovascular structures is crucial. This is to decrease the risk of infection, non-union and further tissue loss. We believe that VAC therapy can be effective to overcome all the aforementioned problems. The daily rental charges for a VAC machine and consumables are significant. This has discouraged many from using the system. However, there have been some reports showing that the increased healing times and downgrading of required operations correlate to decreased overall costs of care. The dressing should also enable larger wounds to be treated in the community with minimal nursing care impact. This would free up hospital beds permitting faster healing of operative patients and preventing waiting list buildup.[28] VAC therapy can be regarded as a method that combines the benefit of both open and closed treatment and adheres to DeBakey's principles of being short, safe, and simple. It has been shown to work and be beneficial to wound healing. VAC therapy is not the answer for all wounds; however, it can make a significant difference in many cases. VAC is most useful in difficult cavity or highly exudative wounds. VAC is a useful tool in moving a wound to a point where more traditional dressings or more simple surgical reconstructive methods can be used. As such it is a well deserved, although at present pragmatic addition to the wound healing armamentarium and the reconstructive ladder.[29,30]

CONCLUSION

VAC Therapy provides sterile and controlled environment to large, educating wound surfaces by controlled application of sub-atmospheric pressure. It prepares wounds for closure via split thickness skin grafting or secondary closure in lesser time leading to less overall morbidity with decreased hospital stay. NPWT is treatment of choice in infected / non – healing wounds, not responding to standard treatment.

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