ORIGINAL RESEARCH PAPER

General Surgery

TO STUDY THE EFFECTIVENESS OF VACUUM ASSISTED CLOSURE (VAC) IN WOUND MANAGEMENT

KEY WORDS: vacuum assisted closure, negative pressure wound therapy

Dr. Nandkishor Narwade Head of department of general surgery, Gujarat Adani Institute of Medical Sciences), phone number: 9920279418, address: staff quarters, Gujarat Adani Institute of Medical Sciences, Bhuj- 370001.

Dr. Rishi Shah * 3rd year resident, department of general surgery, Gujarat Adani Institute of Medical Sciences), phone number: 9586365557, address: 205, Manchharam apartment, Nehru Street, Vapi- 396191.*Corresponding Author

ABSTRACT

Background and objective: Wounds are a major source of morbidity, lead to considerable disability, and are associated with increased mortality; therefore, they have a significant impact on public health and the expenditure of healthcare resources. Vacuum-assisted closure (VAC) uses negative pressure to assist wound healing. The mechanical stimulation of cells by tensile forces may also play a role by increasing cellular proliferation and protein synthesis.

Methodology: A total of 50 cases clinically presenting as ulcer between January 2021 and July 2021 were taken for study. Each case was examined clinically in systematic manner as per the proforma drafted. VAC dressing was done and outcome was measured by recording wound scores on days 4,8 and 12.

Interpretation and conclusion: In our study VAC therapy enhanced granulation tissue formation leading to better wound healing, and faster recovery. VAC is thus a promising new technology in the field of wound healing with multiple applications in a variety of chronic wounds, salvage procedures or as an adjuvant therapy to improve the results of various surgical procedures.

INTRODUCTION:

Vacuum-assisted closure (VAC) is a new technique in the challenging field of management of contaminated and chronic wounds. Vacuum assisted closure (also called vacuum therapy, vacuum sealing or topical negative pressure therapy) is a sophisticated development of a standard surgical procedure, and involves the use of vacuum to remove blood or serous fluid from a wound or operation site. The optimum level of negative pressure appears to be around 125 mmHg below ambient and it is believed that negative pressure assists with removal of interstitial fluid, decreasing localized edema and increasing blood flow. This in turn decreases tissue bacterial levels. Despite the significant costs involved, the technique is said to compare favorably in financial terms with conventional treatments in the management of difficult wounds.[1]

Mechanisms of action of VAC:

Wounds generally heal by primary, where edges are brought into close apposition for example by suturing, or secondary intention, where the wound edges are not opposed and a matrix of small blood vessels and connective tissue must be formed in between in order for keratinocytes to migrate across the surface and re-epithelialise the defect. It is a complex, intricate process. The aims of the process can be considered as minimization of blood loss, replacing any deficits with new tissue (granulation) and restoring an intact epithelial barrier as quickly as possible. In order to achieve healing debris must also be removed; any infection controlled and inflammation eventually cleared. The wound then heals with granulation, remodeling of the connective tissue matrix and finally maturation. The rate of healing may be limited by vascular supply and the capacity of the wound to form new capillaries/matrix. Any disruption in the various processes involved in proliferation, angiogenesis, chemotaxis, migration, gene expression, protein production can lead to a chronic wound. The VAC ensures a closed environment for wounds and, therefore, adheres to universal precautions.[2,3]

Local blood flow:

Morykwas et al used needle probe laser Doppler flowmetry to show that sub-atmospheric pressures of 125 mm Hg resulted in a fourfold increase in blood flow using an excisional wound model in pigs. Further higher increases in pressure (200 mm Hg) were shown to decrease blood flow. There remains confusion as to whether continued pressure leads to an eventual decline in blood flow[9] or a cyclical pattern of blood flow. These direct effects on dermal vasculature are thought to be mediated by influencing vasomotor mediators. However, the indirect effects of mechanical forces exerted on the extracellular matrix inevitably affect the microvasculature contained within it. Vacuum Assisted Closure (VAC) has been shown to positively affect angiogenesis.[4,5,6]

Granulation tissue formation:

In Morykwas' studies using porcine dorsal midline excisional full thickness excisional wound models, alginate impressions were taken daily after treatment with VAC. Volume displacement of these casts demonstrated that VAC treated wounds showed increased granulation tissue formation compared with the controls by 63% and 103.4% (continuous and intermittent suction respectively), although it is not known what effect contraction played to change the size of these wounds.[10]

Bacterial colonization:

Studies using swine wounds inoculated with a human isolate of Staphylococcus aureus and a swine isolate of Staphylococcus epidermidis that were treated with VAC or controlled moist saline dressing showed a more rapid decline in bacterial levels in the VAC treated wounds.

Edema reduction and exudate management:

Clinically VAC removes large amounts of fluid from wounds especially acute burns. The resulting reduction in oedema is thought to aid in the enhancement of blood and nutrient flow into the wound. However, this removal of exudates (which will include metalloproteinases and other inflammatory mediators) from the wound and oedema from the surrounding tissues encourages nutrient movement into the wound area even if blood flow is not increased. Removal of fluid prevents a buildup of inflammatory mediators and encourages diffusion of further nutrients into the wound. This is all beneficial to the healing process especially in the case of chronic wounds where it has been hypothesised that an imbalance of metalloproteinases can inhibit healing.

Objectives of the Study:

- To study the outcome of vacuum assisted closure of wounds.
- To evaluate the positive impact of vacuum assisted closure on wound healing in enhancing granulation tissue

METHODOLOGY:

Source of Data: All patients admitted in General Surgery department of G.K. general hospital, Bhuj, clinically presenting as ulcer between January 2021 and July 2021 were included in the study.

Sample Size: 50 Cases

Inclusion Criteria:
- Patient more than 20 years of age
- Patients presenting with ulcer.

Exclusion Criteria:
- Patients less than 20 years of age
- Patients diagnosed as malignancies.

Sequence of Procedure:

Wound Preparation: Any dressings from the wound was removed and discarded. A culture swab for microbiology was taken before wound irrigation with normal saline. Surgical debridement was done and adequate haemostasis achieved. Placement of foam: Sterile, open-cell foam dressing was gently placed into the wound cavity.

Sealing with drapes: The site was then sealed with a clingo drape ensuring that the drapes covered the foam and tubing and at least three to five centimeters of surrounding healthy tissue.

Application of negative pressure: Controlled pressure was uniformly applied to all tissues on the inner surface of the wound using centralized vacuum pump, which delivered continuous pressures, of negative 125 mm Hg. The foam dressing compressed in response to the negative pressure. The pressure was applied continuously for the first 48 hours and changed as required thereafter.[7]

The outcome was measured using area of wound covered with granulation tissue, and its color and consistency.

RESULTS:

- Most of the patients presenting with wounds were in the age group of 40-50 years (40%)
- Wounds were more common in males38 cases (76%) than in females 12 cases (24%) Male to female ratio 3.2: 1.
- Based on the duration of wounds, cases were grouped into 3 categories: <10 days, 10-30 days and >30 days. Most cases fall in the group > 30 days 28 (56%), 20 cases (40%) in the group 10-30 days and 2 cases (4%) in the group < 30 days.
- Wounds were most commonly located in the foot 25(50%) followed by the leg 18(36%), forearm 2 (4%), thigh 4 (8%). One case of wound in the abdomen was included.
- Based on etiology of wounds, which were determined by history and clinical examination, wounds were divided into Traumatic, Diabetic and Vascular. A major portion 28(56%) of cases fell into diabetic group and 13(26%) into traumatic and 9 (18%) into vascular group.
- Most common organism cultured from the wounds was Staphylococcus aureus 21(42%) followed by Pseudo monas 14 (28%).

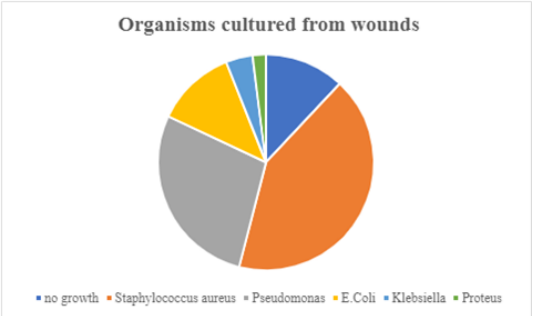

Fig. 1: Organisms cultured from wound (before VAC)

- Following V.A.C. Dressing for 4-12 days, most of the wounds showed improvement in terms of decreased wound surface area, layer of granulation tissue covering wound and quantity of exudate.

Table 1: Comparison of wound surface area after 7 days of dressing

No. Of cases		Wound surface area	
	<20cm2	20-40cm2	>40cm2
Day 0	4	44	2
Day 4	11	37	2
Day 8	13	36	1
Day 12	19	31	0

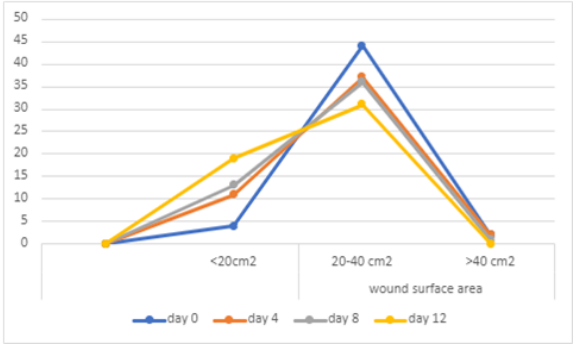

Fig. 2: Graphical representation of wound surface area after 12 days of dressing

DISCUSSION:

Delayed wound healing is a significant health problem and a challenge in the community setting particularly in older adults, often requires daily or more frequent hospital visits. With conventional wound-healing methods, it may take several months to heal the wound. In addition to the pain and suffering, failure of the wound to heal also imposes social and financial burdens. 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.

Reports suggest that negative pressure therapy has the potential for saving money if it is used on the "right patient, the right wound, at the right time." The use of negative pressure therapy has been proposed as a novel method of manipulating the chronic wound environment to assist and accelerate wound healing. Although most studies were probably too small to detect significant differences between wounds managed by conservative dressings and by VAC, some did show VAC to result in better healing than standard methods. VAC appears to be a promising alternative for management of wounds. VAC was also more effective at treating various chronic and complex wounds, with a significantly greater reduction in wound volume, depth and treatment duration for VAC. It has the potential to reduce health care costs, for both hospital and patient, and enhance patient satisfaction and quality of life.[8,9]

In our study, following VAC therapy, wound scoring was done with scores from 1-7 given for area of granulation tissue, color and consistency of granulation tissue. The wounds following VAC therapy can be considered for skin graft. In the present study, >70% cases showed considerable improvement following 12 days of VAC therapy. The use of sub-atmospheric pressure dressings, available commercially as the VAC device, has been shown to be an effective way to accelerate healing of various wounds. The optimal sub-atmospheric pressure for wound healing appears to be approximately 125 mm Hg. 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.

CONCLUSION:

VAC therapy is a recent modality of treatment of wounds. Its introduction has changed the course of management of wounds. Based on the data from the present study and other studies available, VAC does appear to result in better healing and thus looks to be a promising alternative for the management of various wounds. The application of VAC is simple, but requires training to ensure appropriate and competent use. The cost of VAC will vary and depend on the length of hospital stay and cost of supplies. There is a paucity of high-quality randomized control trials on VAC therapy for wound management with sufficient sample size and adequate power to detect differences, if any, between VAC and standard dressings. More rigorous studies with larger sample sizes assessing the use and cost- effectiveness of VAC therapy on different wound types are required. Awareness about VAC and training on application of VAC dressings will allow its utilization more often.

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