

## Original Research Article

# Outcome analysis of vacuum assisted closure therapy in patients with open wounds

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## ABSTRACT

**Background:** Vacuum assisted Closure (VAC) of wound is a recent trend and proven method of fast and better healing of wounds. The basic concept is the removal of blood and serous collection from the wound site with negative pressure and promoting the healing process rapidly by altering the local microcellular environment. The objective of the study was to show the efficacy of healing process in open wounds treated by VAC method of dressing.

**Methods:** In this prospective study, total of 50 patients with upper and lower limbs non-healing open wounds were recruited. Before the application of VAC, surgical debridement was performed to remove all the devitalized necrotic tissues and the wound was packed with povidone iodine. Prior to and at the end of VAC dressing, wound dimensions were noted.

**Results:** Patients mean age was  $46.72 \pm 7.63$  years and out of which 42 patients (84%) were males and 8 patients (16%) were females. All patients had suffered an acute trauma. VAC therapy was applied through continuous or intermittent suction on wounds and dressing were changed every second or third day. After application of VAC therapy all wounds showed improvement, which were indicated by presence of healthy granulation tissue, absence of necrotic tissue and subsequent wound closure.

**Conclusions:** VAC dressing in an open wound is an efficient and safe adjunct to treat severe infections and may be a good alternative to treat the open wounds in selected patients. Short time intervals between VAC changes and short course of therapy result in good patient acceptance. This method is recommended for all the types of non-healing wounds management.

**Keywords:** VAC therapy, Wound, Negative pressure

## INTRODUCTION

Wound healing impairment after surgical procedures and road traffic accident is a common problem in health care. In addition to the pain and suffering, failure of the wound to heal and graft rejection also imposes social and financial burdens.<sup>1,2</sup> 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 optimize

conditions for wound healing and requires fewer painful dressing changes.<sup>3</sup>

The basic concept of this method is removal of blood and serous collection from the wound site by the application of negative pressure. This will be done by applying a piece of foam and a drain over the wound surface after debridement and is covered over by a semi permeable plastic adherent membrane securing it to the skin margin and the drain is connected to a vacuum creating unit.<sup>4</sup> The plastic membrane acts like a barrier, preventing the

contamination from outside environment and the foam will help to distribute the negative pressure uniformly over the entire wound surface area preventing the chance of necrosis at a single place due to high pressure at a single place.<sup>3,4</sup> The standardized average negative pressure applied is around 100 to 250 mm Hg. The interface material used in the VAC therapy stretches the cells at the base of the wound bed, promoting the response for divide and proliferates.<sup>5</sup> It also creates an environment of hypoxia over the surface leading to promotion of angiogenesis in addition, it keeps the wound warm, moist and prevents desiccation.

## METHODS

This prospective study was done at Department of Orthopedics, Sri Aurobindo Medical College and PG Institute, Indore. Study was carried out over a period of one year from July 2016 to June 2017. Total 50 patients, with non-healing open wounds and wounds larger than 50 cm<sup>2</sup> area were included.

### Inclusion criteria

Inclusion criteria were age above 18 years; both gender (male and female); wound size of >2cm; all types of open wounds in upper and lower limbs irrespective of the etiology; patients giving consent for topical negative pressure.

### Exclusion criteria

Exclusion criteria were age <18; charcot disease, ulcers resulting from chemical or radiation burns and malignant ulcers; untreated cellulites and dry gangrene; malignancy in wound; wound with unstable fractures or loose fragments of bone; ulcers over the extremities with peripheral vascular disease; wound with exposed blood vessels or organs; acute burns.

## Materials Needed

- Autoclaved sponge foam
- Ryle's tube
- Disposable syringe (10cc 20cc and 50cc)
- Povidone iodine 10% solution
- Cling drape
- Normal Saline
- Dressing material
- Negative pressure of -100 to -250. Suction kept on for half an hour and off for one and half hour.

## Method of application

After thorough debridement of the wound haemostasis is achieved, wound surface area is measured by imprint of plastic sheet over graph paper from necrotic slough and recorded in cm<sup>2</sup>. Autoclaved Sponge foams of 8 mm thickness is taken and cut in to shape of the wound with slightly larger size than the wound. Wound swab is taken for culture sensitivity. Above the wound surface if there is clean granulation tissue then bactigrass or Vaseline gauge can be applied so that while removal of dressing, the sponge surface will not be adherent to the wound surface and during its removal bleeding can also be reduced. The depending upon the wound size pressure tube/ Ryle's tube with adequate number of fenestrations made is placed between the two sponge layers. The whole wound area is sealed with tegaderm/sterilized polyethylene cover/cling drape/sterile surgical glove. The suction catheter is connected to vacuum creating device and is charged. Syringe, mucus sucker, romo-vac and pedal suction machine is cleared of drainage and recharged with vacuum after each clearance at timely intervals. The method of application of dressings and the negative pressures that can be created with suction, romo-vac, syringe and mucus sucker are shown in Figure 1.



**Figure 1: (A) Left lower limb necrotizing fasciitis wound; (B) Mucus with left lower limb necrotizing fasciitis wound; (C) Primary suturing; (D) Secondary suturing; (E) Removal and pedal suction machine (negative pressure of -100 to -250); (F) Disposable syringe/povidone iodine 10% solution/dressing material; (G) Autoclaved sponge foam with Ryles tube; (H) VAC Dressing application over wound with suction tube.**

Depending upon the type of modality used to create the vacuum, the negative pressure applied can be range from 100 mm Hg to 250 mm Hg. The characteristic of exude fluid and quantity is noted down. The wounds surroundings were inspected at time of change of dressing for any spreading cellulitis or maceration. Dressings are changed at intervals of 48-72 hours depending upon the amount of exudates drained, leakage from the sealed area due to fluid logging in and also upon the condition of the wound and measurements are taken. In case the maceration were found then the next dressing were applied after 12-24 hours so as to allow the skin to get back to the normal state. When surgical glove is used for dressing then, by creating small fenestrations in the distal end of the glove will allow the minimal air leakage and decreases the maceration. The wound swab and exudates obtained in the vacuum device are sent for culture at weekly intervals. The size of the wound is measured every time while changing dressing, over the graph paper and successive measurements will be recorded. The improvement in the wound is assessed by revised photographic wound assessment tool and the scores are noted. The total cost analysis of the dressing for each patient is analyzed separately and recorded.<sup>6</sup> The VAC dressing are done till the granulation tissue of the wound fills upto the skin surface and left for healing by secondary intention or secondary method of wound closure such as secondary suturing, split skin grafting, flap repair.

Data statistically analysed by SPSS -20 software.

## RESULTS

In our study, patient mean age were  $46.72 \pm 7.63$  years (Table 1) and sex distribution 42 patients (84%) were males and 8 patients (16%) were females (Table 2). All patients had suffered an acute trauma with upper and lower limbs non-healing open wounds. Road traffic accident was found to be most common cause with 35 (70.0%) patients, followed by machinery injury in 9 (18%) patients and 6 (12%) patients had a fall from height. Most common co-morbid condition with non-healing infected wound was diabetes mellitus (24%), hypertension (10%) and heart disease (4%) (Table 3) were found in our patients.

**Table 1: Age-wise distribution.**

Age (in years)	Number of patients (%)
<b>18-35</b>	22 (44)
<b>36-50</b>	18 (36)
<b>51-76</b>	10 (20)
<b>Mean Age (46.72)</b>	50 (100)

**Table 2: Gender wise distribution.**

Gender	Number of patients (%)
<b>Male</b>	42 (84)
<b>Female</b>	08 (16)
<b>Total</b>	50 (100)

**Table 3: Co morbid conditions with non-healing wound.**

Co morbid conditions	Number of patients (%)
<b>Diabetes mellitus</b>	12 (24)
<b>Hypertension</b>	05 (10)
<b>Ischemic heart disease</b>	02 (04)
<b>None</b>	31 (62)

**Table 4: VAC pressure applied.**

Pressure	Number of patients (%)
<b>&gt;150 mm of Hg</b>	38 (76)
<b>100-150 mm of Hg</b>	4 (08)
<b>Upto 100 mm of Hg</b>	8 (16)

VAC was applied with an intermittent suction after every one and half hours. VAC pressure of above 150 mm of Hg was applied to the maximum patients (76%), in 8% patients, pressure was between 100 to 150 mm of Hg and upto 100 mm of Hg in 18% of patients (Table 4). VAC was changed every second or third day depending upon the presence of infection/slough in the wound and initial response to the VAC therapy. Patients needed about 15 days of VAC therapy on an average, with four to five VAC applications, ranging from 02-15 applications. All the wounds responded to the VAC therapy. Wound healing was evaluated in terms of microbial clearance, granulation tissue formation and reduction in wound size (Table 5).

**Table 5: VAC therapy results.**

No. of patients	No. of VAC dressings used	No. of surgical debridement	Time to complete microbial clearance (days)	Surgical procedures done
<b>24</b>	3-4	2	9-14	Healing by secondary intention
<b>26</b>	5-6	2	8-9	Secondary suturing

## DISCUSSION

VAC therapy as a treatment method, have been used in the past for superficial tissue loss such as burns and

pressure injuries, have found new areas of use in severe soft tissue loss, associated with orthopedic infections, diabetic foot as well as tumor surgeries. For those injuries that require long term administration of antibiotics and

special techniques such as free tissue transplantation, care is a complicated process VAC therapy provides an occlusive environment which increases the rate of granulation, reduces edema, bacterial colonizations and reduces the pain caused by the wound.<sup>6-10</sup> It has been suggested that successful healing correlates with less than 10 organisms per gram of tissue. The number achieved with wound VAC therapy is usually less than ten.<sup>5,11</sup>

The chronic wounds are one of major causes of hospitalization of patients in surgical departments resulting in high cost for management, utilization of resources and man power. The VAC therapy has shown to decrease the time and cost of hospitalization to almost half. It is proved superior with respect to the time to complete healing and wound bed preparation time compared with conventional wound care.<sup>12</sup> It prevents frequent pain experience, patients had during frequent change of such large wounds dressings.<sup>13</sup>

Complications associated with VAC technique include localized infection, bad odour, toxic shock syndrome and anasarca.<sup>14,15</sup> Many modern therapies for chronic wounds have been advocated which include ultrasound, laser therapy, electrical stimulation, and electromagnetic waves. During electrotherapy, the cells in the wound are stimulated electrically through electrodes or pulsed magnetic fields to induce healing, but failure of electromagnetic waves to reduce the wound size, cost of treatment and lack of evidence to support the use of low level laser therapy for wound healing have shown that VAC therapy is most cost effective and efficient therapy for all non-healing wounds which do not respond to conventional wound care methods.<sup>15-17</sup>

## CONCLUSION

Vacuum assisted wound closure has the advantage of rapid healing, easy application, safe and cost effectiveness. Rates of graft loss may be lower when negative pressure wound treatment is used. Short time intervals between VAC changes and short course of therapy result in good patient's compliance.

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