Section: General Surgery

Original Research Article

COMPARISON OF THE EFFECTS OF VACUUM ASSISTED CLOSURE THERAPY WITH CONVENTIONAL DRESSINGS IN PATIENTS WITH CONTAMINATED WOUNDS-OUR EXPERIENCE FROM A TERTIARY CARE CENTRE IN SUB-HIMALAYAN REGION

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Abstract

Background: Vacuum-assisted closure (VAC) is an advanced technique used for managing both acute and chronic contaminated wounds. It involves a wound dressing system that applies continuous or intermittent sub-atmospheric pressure to the wound surface, aiding in debridement and promoting healing. The ideal pressure for VAC is approximately 125 mmHg below ambient levels. This negative pressure helps remove interstitial fluid, reduce localized edema, and enhance blood circulation, thereby lowering bacterial levels and facilitating the healing process. **Materials & Methods:** Quasi experimental study and hospital-based study. **Results:** Mean hospital stay was significantly less in VAC group (6.4 +/-3.34 days) as compared to the dressing group (9.1+/- 3.51 days). In our study the mean cost of treatment was higher in Dressing group (10861 ± 3318 INR) as compared to the dressing group 10272 ± 2738 INR). In our study, the mean wound area in the conventional dressings group reduced to 25% and in the VAC group it was reduced to 75%. In our study a much higher number of patients needed re-debridement in conventional dressing group i.e. 73.1% patients whereas only 27% patients needed re-debridement in VAC group. **Conclusion:** The comparison between Vacuum Assisted Closure (VAC) and conventional dressings highlights the clear advantages of VAC in promoting faster wound healing, lesser complications, shorter duration of hospitalization, being more cost effective and improving overall patient outcomes. This reiterates its potential to revolutionize wound care practices.

INTRODUCTION

Damage or disruption of normal anatomical structure and function of a tissue is referred to as a wound.[1] Wound might be as little as a split in the skin epithelium, or it can be more severe and extend into subcutaneous tissue, causing harm to other tissues including muscles, tendons, arteries, nerves, parenchymal organs, and even bone.[2]

Over the years, significant advancements have been made in wound care, with vacuum-assisted closure (VAC), also known as negative pressure wound therapy (NPWT), emerging as one of the most transformative techniques in the field. This unique and versatile system optimizes wound healing by applying sub-atmospheric pressure to reduce inflammatory exudate and promote granulation tissue formation. VAC/NPWT is particularly valuable in managing both acute and chronic wounds. These include open fasciotomy wounds, diabetic foot ulcers, and even closed surgical incisions. The technique has undergone considerable evolution since its first modern-day application in the 19th century. This essay provides a comprehensive overview of VAC/NPWT, discussing its mechanisms, applications, advantages, limitations, and future directions. The origins of NPWT date back to the 19th century when basic principles of negative pressure in wound management were first recognized. However, it wasn't until the late 20th century that the technique gained clinical significance, with the advent of modern vacuum devices. These devices transformed wound care, enabling precise pressure control, enhanced patient comfort, and broader clinical applications.

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VAC/NPWT has diverse applications in both open and closed wounds, making it an integral part of modern surgical practice. Acute wounds that cannot be closed primarily due to infection risk, swelling, or skin tension. Chronic wounds, such as pressure ulcers and non-healing diabetic ulcers. Post-surgical wounds with dehiscence or delayed healing. Traumatic wounds with extensive tissue loss or contamination. Skin grafts requiring enhanced adherence and vascular integration. A significant advancement in NPWT is the integration of fluid instillation. This approach involves infusing solutions, such as saline or antibiotics, into the wound bed, followed by a period of negative pressure application. The process enhances the cleansing effect, delivers localized therapy, and reduces bacterial burden, making it a valuable addition to standard NPWT.

Advantages of Vacuum Assisted Closure

Vacuum assisted closure has advantage over conventional dressings as these can be used in (a) large open wounds where stability of the wound margin may be promoted in conjunction with application of the 9 seal dressing, (b) where there is frequent need of dressing changes, (c) where heavily exudating wounds are present with a concurrent reduction in soft tissue oedema, (d) where the reduction in soft tissue oedema will allow increased tissue perfusion, (e) where rapid closure of large wounds is desired and (f) in primary closed wounds.[3]

Aims and Objectives

Aim of the Study: To determine the role of Vacuum Assisted Closure (VAC) in open wound healing.

Objectives: To compare the effect of Vacuum Assisted Closure (VAC) therapy with Conventional Dressings in patients with open wounds with respect to rate of healing, treatment duration and cost and complications.

MATERIALS AND METHODS

The study was conducted in the Department of General Surgery, SRHU, Swami Ram Nagar, Dehradun over a period of 1 year. All the patients admitted under the department of General Surgery was enrolled for the study after obtaining written informed consent and clearance from institutional ethics committee.

Type of Study

Present study was a Quasi experimental study and hospital-based study.

Sample Size

Total 51 patients with open wound, 25 in VAC therapy and 26 in conventional dressings group were included in the study, by adopting the consecutive sampling method, considering the hospital records of previous years.

Sample Selection Method

Consecutive sampling

Inclusion Criteria

1. All patients with open wound up to 10 cm x10 cm size
2. Above 18 years and below 70 years of age

Exclusion Criteria

1. Patients with coagulopathy
2. Patient with venous disease
3. Ulcer with the underlying osteomyelitis
4. Charcot's joint
5. Peripheral vascular disease.
6. Very large wound 15x15 cm2

Study Tools

A predesigned semi-structured case recording proforma was used to collect the data.

Study Protocol

1. General biodata of the patient including name, age, gender, occupation and address with complaints of open wound up to 10x10 cm size visiting the hospital was included in the study.
2. A detail history with specific reference about mode of onset, duration of illness, evolution was taken, followed by a complete general physical, local wound examination and systemic examination.
3. The patients were randomly assigned to two groups using a lottery method. Chits labeled as “A” and “B” were prepared, with Group A representing the VAC (Vacuum-Assisted Closure) group and Group B representing the Conventional Dressing group. Each patient picked up the chit to determine their group allocation, and they were also given the option to exchange their chit if they desired. This process ensured an unbiased initial distribution of patients between the two treatment groups while accommodating patient preferences.
4. Relevant investigations were done as per the requirement of patient
5. In our study, the cost of treatment was meticulously categorised into several components, providing a clear framework for understanding the financial implications of wound care management. Fixed bed charges were established at Rs 700 per day, reflecting the basic costs associated with patient accommodation. The use of Vacuum-Assisted Closure (VAC) dressing was a significant factor in treatment costs, with prices varying according to wound size: Rs 6500 for wounds greater than 8 cm, Rs 5000 for those between 5 and 8 cm, and Rs 4000 for wounds smaller than 5 cm. In contrast, conventional dressing incurred a cost of Rs 400 per dressing. The number of dressings applied was determined by several variables, including the degree of soakage and the specific profile of each patient, ensuring tailored treatment approaches. Twice daily dressings were preferred in initial part of treatment. Typically, VAC dressings were utilized for a period ranging from 5 to7 days, with their removal based on the level of exudate collected in the cannister.

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6. This detailed breakdown of treatment costs underscores the economic considerations inherent in the choice of wound care modalities and highlights the need for personalized treatment strategies in optimizing both clinical outcomes and cost efficiency.
7. Confidentiality was maintained and data was collected after written informed consent. The patient was studied as per the working proforma attach and their outcome was studied.

VAC Method

There are eight steps in the VAC process. They are as follows

1. Under all aseptic precautions meticulous wound cleaning was done using 5% povidone iodine
2. Using scissors, the foam dressing is trimmed to the approximate size of the wound and is carefully placed over the wound.
3. Perforated drain along with vacuum cup was placed over the foam dressing.
4. The adhesive polyurethane translucent film is then applied to the whole foam, including the drainage tube along with vacuum cup, and the surrounding healthy skin to make an airtight seal.
5. The other end of the tube is connected to the VAC unit, which is then set up to provide the necessary amount negative pressure of 75-125mmhg.
6. The dressing was secured using cotton pads, gamgee and microporous surgical tape.
7. The VAC unit is then turned on, the foam collapses inward, dragging the margins of the wound along with it.
8. The fluid from the wound gets absorbed through the foam and gets sucked into the disposable container of the Vacuum machine.

Data Management and Statistical Analysis

The data entry was done in the Microsoft EXCEL spreadsheet and all data was analysed with SPSS software (version 26). The categorical variables were presented in the form of number and percentage (%). The descriptive statistics was done using mean, standard deviation, proportions and percentages.

RESULTS

Out of 51 patients who were enrolled in the study, 26 (51%) patients were taken in conventional dressings group and 25 (49%) patients were taken in VAC group. 53. [Table 1]

Among a total of 51 patients, 18 patients were between 18 years to 40 years of age. Out of 26 patients in conventional dressings group 9 (34.6%) out of 25 patients in VAC group 9(36%) patients were between 18 years to 40 years of age. Among a total of 51 patients, 18 patients were between 41 years to 60 years of age. Out of 26 patients in conventional dressings group 7 (26.9%) and out of 25 patients in VAC group 11(44%) patients were between 18 years to 40 years of age. Among a total of 51 patients, 15 patients were more than 60 years of age. Out of 26 patients in conventional dressings group 10 (38.5%) and out of 25 patients in VAC group 5 (20%) patients were of more than 60 years of age. [Table 2]

The mean duration of hospital stay was significantly less in VAC group (6.4 ± 3.34 days) as compared to the dressing group (9.1± 3.51 days). Out of 26 patients who were managed with conventional dressings 7(26.92%) patients and out of 25 patients in the VAC group 13(52%) patients were discharged either on or before 7 days of their admission. Out of 26 patients who were managed with conventional dressings 19(73.08%) patients' and out of 25 patients in the VAC group 12(48%) patients were discharged after 7 days of their admission. [Table 3]

The mean cost of treatment was higher in Dressing (10861 ± 3318 INR) as compared to the VAC group (10272 ± 2738 INR). Out of 26 patients who were managed with conventional dressings 4(15.38%) patients and out of 25 patients in the VAC group 6(24%) patients, the cost of treatment was less than Rs 7500.Out of 26 patients who were managed with conventional dressings 22(84.62%) patients' and out of 25 patients in the VAC group, 19(76%) patients the cost of treatment was more than Rs 7500. [Table 4]

In the conventional dressings group the initial mean wound area was 24.09cm2 and in the VAC group initial mean wound area was 47.68cm2. Following 4 weeks of therapy, the mean wound area in the conventional dressings group reduced to 18.11cm2(25%) and in the VAC group it reduced to 12.08cm2(75%). [Table 5]

Among a total of 51 patients, 27 did require re-debridement. Out of 26 patients in conventional dressing group, 19(73.1%) and out of 25 patients in VAC group, 8(32%) patients underwent re-debridement. Among a total of 51 patients no re-debridement of wound was done in 24 patients. Out of 26 patients in conventional dressing group, 7(26.9%) and out of 25 patients in VAC group, 17(68%) patients did not require re-debridement. [Table 6]

Following 4 weeks of treatment, among a total of 51 patients, repeat dressings was needed in 7 patients. Out of 26 patients in conventional dressing group, 6(23.08%) and out of 25 patients in VAC group, 1(4%) patient needed repeat dressings. Following 4 weeks of treatment, among a total of 51 patients,

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continued antibiotics were needed in 8 patients. Out of 26 patients in conventional dressing group, 7(26.92%) and out of 25 patients in VAC group, 23(92%) patients needed continued antibiotics. Following 4 weeks of treatment, among a total of 51 patients, 36 patients did not need any further surgical intervention. Out of 26 patients in conventional dressing group, 13(50%) and out of 25 patients in VAC group, 23(92%) patients did not need any further surgical intervention. [Table 8]

Table 1: Number of patients in study groups

Study Group	Number	Percent
Dressing	26	51
VAC	25	49
Total	51	100

Table 2: Distribution of cases according to age

Age in years			Dressing	VAC	Total
N		%	N	%	N
18-40	9	34.6	9	36	18
41-60	7	26.9	11	44	18
>60	10	38.5	5	20	15
Total	26	100	25	100	51

Table 3: Duration of Hospital Stay

Duration of Hospital Stay	Dressing		VAC	
	N	SD/%	N	SD/%
Mean duration in Hospital	9.1	± 3.51	6.4	± 3.32
<=7 days	7	26.92	13	52
>7 days	19	73.08	12	48
Total	26	100	25	100

Table 4: Cost of treatment

Cost	Dressing		VAC	
	N	SD/%	N	SD%
Mean cost (INR)	10861	±3318	10272	±2738
<7500	4	15.38	6	24
>7500	22	84.62	19	76
Total	26	100	25	100

Table 5: Distribution of patients according to Wound size and Surface area Mean (Cm2)

Distribution of patients according to Wound size and Surface area Mean (Cm2)		Dressing	VAC
1.	Initial Wound Area	24.09 cm2	47.68 cm2
2.	Wound Area After 4 weeks of therapy.	18.11 cm2	12.08 cm2
3.	Percentage decrease in surface area	25%	75%

Table 6: Need for Re-debridement

Re-debridement	Dressing		VAC		Total
	N	%	N	%	N
Yes	19	73.1	8	32	27
No	7	26.9	17	68	24
Total	26	100	25	100	51

Table 7: After 4 weeks of treatment need for additional dressings, antibiotics or no surgical intervention

After 4 weeks of treatment	Dressing		VAC		Total
	N	%	N	%	N
Repeat dressings	6	23.08	1	4	7
Antibiotics	7	26.92	1	4	8
No further intervention	13	50	23	92	36
Total	26	100	25	100	51

DISCUSSION

In present study, out of 51 patients 36 (70%) patients were between 18 to 60 years of age. Similar results were seen in the study by Patra et al., patients affected were most commonly in the age group of 41-60 years.[4] In Mir et al study the age ranged from 10 to 80 years with majority i.e., 25% being 31-40 years of age.[5] Due to their spending more time in outdoor living and outdoor activities, patients in their prime and productive years may be more susceptible to trauma and unintentional injuries, which might account for the elevated incidence in the 40–60 age range.

In our study the mean duration of hospital stay was significantly less in in VAC group (6.4 ± 3.34 days) as compared to the dressing group (9.1± 3.51 days). Similar findings were observed in the study by S

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Tanwar et al. which showed a significantly shorter duration of hospital stay (8.14 ± 3.13 days) with VAC dressings and longer hospital stay (11.36 ± 4.75 days) with conventional dressing.[2]

In our study the mean cost of treatment was higher in Dressing group (10861 ± 3318 INR) as compared to the dressing group (10272 ± 2738 INR). The findings were similar in the study by J. Apelqvist et al. which showed the average total direct cost per patient treated for 8 weeks or longer was $27,270 in the NPWT group compared with $36,096 in the standard moist wound treatment group, yielding an incremental cost difference of $8,826. Proportionally, the highest costs were related to inpatient hospital stay, antibiotics, and wound treatment (dressings and staff). Together, these service components accounted for most total treatment costs in both treatment groups.[6] A similar study was done by Moues et al. showed a significantly higher mean material expenses for wounds treated with Vacuum therapy (414 ± 229 Euros) compared with conventional therapy (15 ± 11; Euros), but significantly lower mean nursing expenses (33 ± 31 and 83 ± 58 Euros) for Vacuum therapy and conventional therapy respectively). Hospitalisation costs were lower in the Vacuum therapy group (1788 ± 1060 Euros) than in the conventional treatment group (2467 ± 1336 Euros) due to an on average shorter duration until they were 'ready for surgical therapy'. The total costs per patient between the two therapies (2235 ± 1301 Euros for Vacuum versus 2565 ± 1384 Euros for conventional therapy), Vacuum therapy was slightly cheaper.[7] These findings were also consistent with our study.

In our study a much higher number of patients needed re-debridement in conventional dressing group i.e. 73.1% patients whereas only 27% patients needed re-debridement in VAC group. In similar study Kumar b al. both the groups needed repeated debridement till the end of first week. However, by the end of week 2, there was no need for debridement in VAC group whereas conventional dressing group still needed repeated debridement. By the end of third and fourth weeks both the groups needed similar frequency of debridement. In the study by James SMD et al,[22] patients needed re-debridement in the VAC group, whereas 24 patients of conventional dressing group needed re-debridement. These results of similar study are consistent with our study that a VAC application results in less requirement of re-debridement and hence better outcome.[8]

In our study following 4 weeks of therapy, the mean wound area in the conventional dressings group reduced to 25% and in the VAC group it was reduced to 75%. These results were similar to the study by Lone et al. which showed Wound size decreased in 78.6% in VAC group whereas 53.6% in conventional dressings Group. Most wounds in VAC Group i.e. 81.8% got closed in 5 weeks as compared to only 60% in conventional dressings group in 8 weeks.[9] In the study Kumar b et al. At the end of four weeks, wound size reduced in both the groups compared to week 1, but no significant difference was seen between the both the groups.[7]

In our study following a treatment course of 4 weeks, 23% patients needed continued repeat dressings and 27% patients needed continued antibiotics in the conventional dressing group. Whereas only 4% patients needed repeat dressings and antibiotics in VAC group. This shows a significantly higher need of repeat dressing and antibiotics after 4 weeks of treatment in the conventional dressing group. In similar study Kumar B et al. showed following 4 weeks of treatment, patients in VAC group required less frequency of dressing change (p=0.0001) when compared to patients who underwent conventional dressings.[10] In the study by James SMD et al. the time to complete wound healing was found to be 21 days in VAC therapy versus 34 days in conventional dressing. This shows that wound healing is better when VAC dressings are done with lesser number of repeated dressings and treatment.[8]

CONCLUSION

In conclusion, the comparison between Vacuum Assisted Closure (VAC) and conventional dressings highlights the clear advantages of VAC in promoting faster wound healing, lesser complications, shorter duration of hospitalization, being more cost effective and improving overall patient outcomes. This reiterates its potential to revolutionize wound care practices.

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