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A Study of Wound Healing by Two Methods: Vacuum-Assisted Closure and Conventional Dressing Closure

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Abstract

Background: *Chronic wounds and diabetic wounds are often presented in the surgery unit. The main aim of treatment is to initiate wound healing as quickly as possible without complications. We in the current study tried to compare the healing by vacuum-assisted healing versus conventional dressing method.* ***Methods:*** *This cross-sectional study was done on n=50 cases admitted in the Department of General Surgery, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Patients underwent a detailed history and general physical examination followed by systemic examination and laboratory investigations including CBC, FBS, PPBS, HbA1c, RFT, BT, CT, HCV, and if required arterial doppler and radiological investigations. The cases were randomly allotted in two different groups of n=25 each. Group I (Vacuum-assisted closure) and Group II conventional dressing.* ***Results:*** *The mean percentage of granulation tissue formation in group I was 85.05% appeared on the 8th day of the dressings and in group II the mean granulation formation was 56.03% on the 8th day of the dressings. There was a statistically significant difference noted in the appearance of granulation tissue in both methods. Group I, showed significantly greater granulation tissue formation as compared to group II. The Wound Contracture of the wound for VAC dressings was 12.4% and 5.3% in conventional dressings in our study was statistically significant in Group I as compared to group II dressings.* ***Conclusion:*** *Within the limitations of the present study, it was found that overall duration of hospital stays, granulation tissue formation, and wound contracture were found to be better in vacuum-assisted closure as compared to the conventional closure method. The total number of debridement needed to do were less and the post-operative complications were also found to be less in vacuum-assisted closure, and it was also found to be economically better. Therefore, VAC must be applied infeasible cases for wound closures.*

Keywords*: VAC dressings, Conventional dressings, granulation tissue, wound contracture, grafting.*

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Introduction

Acute and Chronic injuries leading to wounds are an important cause of morbidity and affect the quality of life. Approximately 1% of the population is affected and is a big risk factor for hospitalizations, amputations, sepsis, and mortality. Wounds which are showing characteristics of delayed healing or non-healing are a problem that gives rise to various complications. Therefore, treatment of wounds, pain, and discomfort remains a big significant challenge. [1-3] Regardless of etiology, wounds are difficult to treat if coexisting factors such as infection or diabetes mellitus prevent regular wound healing. Diabetes mellitus is the commonest cause, especially in developing countries. It is estimated that in the year 2014, around 422 million people worldwide were suffering from diabetes mellitus WHO. [4] The

lifetime risk of developing limb ulcers mainly in the foot, among diabetics has been estimated to be 15%. [5] Although wound dressing has been used for thousands of years, there exists no ideal dressing. Surgical dressing of both open and closed wounds is based mainly on tradition, training, and the surgeon's own choice. Modern wound-healing concepts include different types of moist dressings and topical agents, although only a few of these treatments have convincingly been shown to give higher wound closure rates compared with traditional wet gauze dressings. The Modern wound-healing concepts include differing types of moist dressings and topical agents, although only a couple of these treatments have convincingly been shown to offer higher wound closure rates compared with traditional wet gauze dressings. 8-10 During the last 20 years a good sort of innovative dressings are introduced. The negative pressure wound dressing may be a new technology that has been shown to accelerate granulation growth and promote faster healing, thereby decreasing the amount of time between debridement and definite surgical closure in large wounds. However, the clinical knowledge about the management of difficult-to-treat wounds is still limited owing to the lack of high-quality evidence. During the past few years, many clinical trials have been initiated, and the first results have been reported in leading journals. Topical negative pressure using Vacuum-assisted closure (VAC) also called vacuum therapy, vacuum sealing or topical negative pressure therapy is a sophisticated development of a standard procedure to remove the blood and serous fluid from a wound compared to conventional dressing which uses saline gauze for the same purpose. VAC provides a new paradigm for wound dressing and is a wound management technique that exposes wound beds to a controlled negative pressure by a way of a closed system. It provides an ideal environment which is necessary for wound healing. [6, 7] Therefore, with this background we in this study intend to establish the efficacy of VAC in comparison with conventional dressings in wound healing.

Materials and Methods

This cross-sectional study was conducted in the Department of General Surgery, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical permission was obtained for the study. Written consent was obtained from all the participants of the study. The cases were divided into two groups of n=25 each. In the group I cases the dressing was Vacuum-assisted closure (**VAC)** and in group II the dressing was done by the conventional method.

Inclusion criteria

1. Patients aged > 18 years with chronic wounds
2. Diabetic and non-diabetic ulcers
3. The wound site is lower limbs.
4. Size is > 4 X 4 cms

Exclusion criteria

1. Osteomyelitis
2. Malignant ulcers
3. Ischemic ulcers
4. Exposed vessels
5. Patients with bleeding disorders

The selected patients will be subjected to a detailed history which included durations of symptoms, predisposing factors, previous history of treatment. Medical history of hypertension, diabetes mellitus, or any other disease was noted followed by clinical examination. All patients underwent detailed clinical examination and the laboratory investigations included CBC, FBS, PPBS, HbA1c, RFT, BT, CT, HCV, and if required arterial doppler and radiological investigations, and the wounds were thoroughly debrided and the ulcer dimensions as well as the surface area assessed. Before surgical intervention at the end of VAC therapy, the final appearance of the wound was again noted and recorded. The patients were followed up daily in both test and control groups. The control group was subjected to dressings by conventional methods whereas the test group was subjected to topical negative pressure dressings and was left undisturbed for 3 days. The VAC dressing is a combination of composite synthetic hydrocolloid sheet dressing with vacuum-assisted wound closure systems. The technique involves the following steps. All the patients included in Group I were subjected to these steps. The wound was thoroughly debrided, and devitalized tissue removed. A perforated drain tube was placed on top of the wound bed and another end was brought out a

little away from the main wound. The hydrocolloid foam dressing soaked in povidone-iodine solution was cut to the size of the wound and applied over the drain tube. The foam with the surrounding normal skin was covered with an adhesive, semipermeable, transparent membrane. A good air seal was thus ensured around the wound. The distal end of the drain tube was now connected to a device, which provided a negative pressure of negative 125 mmHg was applied to the wound, either continuously or intermittently (5 minutes "on", 2 minutes "off"). This was achieved by wall suction apparatus, computerized devices, or mobile suction drain devices. Suction was applied continuously or intermittently based on the amount of wound discharge. Once the vacuum is applied, the foam must be seen collapsed into the wound bed, thus giving the surface a concave appearance. The fluid from the wound is absorbed by the foam and is removed from the wound bed by suction. For group II cases, Conventional dressing was done after debridement and using hydrogen peroxide, betadine solution followed by saline wash and applying moist gauze and cotton pad. Repeated dressings changed every 1 or 2 days depending upon soakage. The negative pressure was maintained for an average of 3 days for Maximum benefit as studies have proved. Once adequate granulation tissue was formed the dressing was removed, and definitive wound closure was achieved by skin grafting. At the end of three days, the wounds in both groups were inspected after the removal of the dressings. The wounds were compared based on the following parameters. They are the Rate of granulation tissue formation as a percentage of the ulcer surface area wound contracture in millimeters. All the available data was uploaded on an MS Excel spreadsheet and analyzed for the continuous variables mean and Standard deviations were used and for categorical variable comparison of two groups and Chi-Square for the association. SPSS Version 19 was used.

Results

Out of n=25 cases in group I and group II most common age group affected was 31 – 50 years with 58% of all cases. The mean age of the cohort of the study was 35.66 ± 4.5 (Table 1). In group I out of n=25 cases, n=16 cases were male and n=9 cases were females similarly, for group II out of n=25 cases n=17 were males and n=8 were females.

Table 1: Comparison of Age Distribution cases in the study

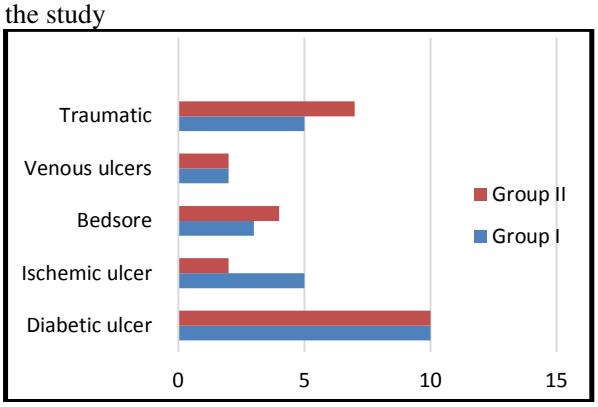
Age in yrs	Group I Vacuum-assisted closure	Group II Conventional closure	Total (%)
18 – 30	2	1	3(6)
31 – 40	8	6	14(28)
41 – 50	7	8	15(30)
51 – 60	5	6	11(22)
61 – 70	2	2	4(8)
> 70	1	2	3(6)
Total	25	25	50(100)

The mean duration of hospital stay was 16.02 ± 4.5 days in conventional dressings as compared to 8.76 ± 2.2 days in VAC dressings. There is a statistically significant difference in the duration of hospital stay in both methods of dressings (table 2). In this study, the most common wound was diabetic ulcers followed by traumatic wounds depicted in figure 1.

Table 2: Mean duration of hospital stay in two groups of the study

Group	Patients	Mean	SD	Min.	Max.	p-value
Group I	25	8.76	1.20	7	15	<0.012*
Group II	25	16.02	4.50	15	20	

Figure 1: Type of ulcer presented in patients of the study



In group, I the number of debridement procedures patients underwent 0, 1, and 2 times was 56%, 40%, and 4% respectively for Group II the number of debridement procedures the patients underwent included for 0, 1, and 2 times included 24%, 64%, and 12% respectively. The overall number of debridement procedures in group II was significantly greater than that of group I depicted in table 3.

Table 3: Distribution of patients according to numbers of debridement

Number of debridement	*Group I*		*Group II*		p-value
	N	*%*	*N*	*%*	
0	14	56.0	6	24.0	0.0112*
1	10	40.0	16	64.0	
2	1	4.0	3	12.0	
Total	25	100	25	100	

*Significant

The mean percentage of granulation tissue formation in group I was 85.05% appeared on the 8th day of the dressings and in group II the mean granulation formation was 56.03% on the 8th day of the dressings. There was a statistically significant difference noted in the appearance of granulation tissue in both methods. Group, I showed significantly greater granulation tissue formation as compared to group II depicted in table 4. The Wound Contracture of the wound for VAC dressings was 12.4% and 5.3% in conventional dressings in our study was statistically significant in Group I as compared to group II dressings.

Table 4: Granulation tissue formation in percent of ulcer area

Granulation percentage	*Group I N (%)*	*Group II N (%)*
21-30	0(0.0)	1(4.0)
31-40	0(0.0)	10(40.0)
41-50	4(16.0)	7(28.0)
51-60	2(8.0)	1(4.0)
61-70	4(16.0)	2(8.0)
71-80	3(12.0)	1(4.0)
81-90	5(20.0)	2(8.0)
91-99	6(24.0)	1(4.0)
Total	25(100)	25(100)

Discussion

Wound care is an important aspect of providing physical protection to the raw surfaces, absorbing exudates, controlling infections by local medications, and providing an optimal environment for wound healing. Various techniques have been used for this process and several studies have been conducted for comparing various modalities of treatment of wounds. The locally applied negative pressure dressing is a very important option in countries like India where it is cost-effective. In the current study, we found that vacuum therapy in wounds generally results in improved wound healing and shortens the duration of hospital stay as compared to the conventional method. This is reflected by on average healthier wound conditions i.e., faster healing, rapid appearance of granulation, and wound contracture. In a similar study by Nagaraj et al., [8] assessing the feasibility and efficacy of topical negative pressure (TNP) dressing using a locally constructed TNP device and comparing it with regular gauze dressings for large wounds found the average duration of hospital stay was lesser in the TNP dressing as compared to the conventional dressing. They also reported the average time taken for granulation tissue formation was 13.71 days for TNP as compared to 24.35 days in conventional dressings. Correction of anemia done was done using hematinics and blood transfusion whenever necessary to promote healing in this study. Appropriate antibiotics are used after empirical therapy after considering culture and sensitivity. Glycemic control was achieved using regular insulin if needed a long-acting Insulin (basalog) also was added. Although the exact mechanism of action of negative pressure on wound healing is unknown it has been proposed that the application of negative pressure promotes the local blow flow reduces edema and decreases the bacterial colonization rates. It has been found that the negative pressure also promotes the rapid formation of granulation tissue provides a moist environment and removes excess exudates all these leads to the creation of an ideal environment for wound healing. [9] The mean percentage of granulation tissue formation in group I was 85.05% appeared on the 8th day of the dressings and in group II the mean granulation formation was 56.03% on the 8th day of the dressings. AM Lone et al., [10] found granulation tissue appeared in 92.85% cases in 14 days in the VAC group in contrast with the conventional group 53.57%. The observations are similar to our observations however the endpoint is taken as the 8th day in the current study. Contracture of the wound for VAC dressings was 12.4% and 5.3% in conventional dressings in our study, compared to A. Bayoumi et al., [11] in with wound contracture was 10.76% and 2.05% with the initial size of the wound.

Conclusion

Within the limitations of the present study, it was found that overall duration of hospital stays, granulation tissue formation, and wound

contracture were found to be better in vacuum-assisted closure as compared to the conventional closure method. The total number of debridement needed to do were less and the post-operative complications were also found to be less in vacuum-assisted closure, and it was also found to be economically better. Therefore, VAC must be applied infeasible cases for wound closures.

***Conflict of Interest*: None**
***Source of support*: Nil**
***Ethical Permission*: Obtained**

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