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Comparison of Negative Pressure Wound Therapy v/s Conventional Dressing on Chronic Ulcers at Tertiary Health Centre

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Abstract

Introduction: Negative pressure wound therapy (NPWT) provides a novel option for wound treatment. Negative pressure wound therapy is a wound treatment method that subjects the wound bed to negative pressure by means of a closed system. Negative pressure wound therapy gives a moist wound healing environment that is essential for wound healing. **Materials and Methods:** The study was held in the surgery department of a tertiary care centre with total 50 numbers of patients of age 18 years and above. Patients were examined clinically, and necessary investigations done. **Results:** The difference in the rate of wound contraction was apparent since 5th day and by the time of discharge/intervention, means percentage of wound contraction was 90.9% in Negative pressure wound therapy as compared to 74.54% in conventional group patients. Mean hospital stay was significantly more in similar cases managed by conventional dressing as compared to Negative pressure wound therapy (17.23 *vs* 11.13 days). **Conclusion:** Present study showed that Negative pressure wound treatment appears to be a better option to conventional chronic wound dressings with early development of granulation tissue, rapid wound contraction and reduced hospital stay.

Keywords: Chronic Wounds, Negative Pressure Wound Treatment, Vacuum Assisted Closed Dressing

1. Introduction

Patients having chronic ulcers form sizable chunks of healthcare burden in hospitals. Success rates in such cases depend on sound knowledge of wound care and various products available at our disposal.

Wound treatment in early Egyptian civilization shows close resemblance to modern practices. The Egyptians were first to use the "moist wound healing" concept.

A number of treatment methods have been found over the years to treat wounds with different types of dressings. Some commonly used applications include placenta extracts, collagen particles, povidone iodine, eusol dressings, silver sulfadiazine etc. An ideal wound dressing should not only control infection but also protect the normal tissue and help in optimal healing of the wound[1,2].

Negative pressure using drains has been used in the treatment of ulcers since as early as the 1940s[3,4]. The negative pressure therapy for treatment of open wounds was developed in Germany and the USA in early 1990's[5-7].

Negative pressure therapy is based on uniformly applied local negative pressure to the wound. The ulcer is covered by a foam dressing material within an airtight film. The dressing is connected with help of suction tubes to a control unit which helps in applying negative pressure to the wound surface in a controlled manner. Mostly

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80-125 mm Hg of pressure is applied. The fluid is sucked out from the ulcer and is collected in a jar.

Negative Pressure Wound Therapy (NPWT) has now been recommended for almost all types of wounds to promote healing in diabetic wounds, leg ulcers, chronic infected wounds, traumatic ulcers, etc.

Very little information is available on the use of NPWT for treatment in chronic leg ulcers. Hence present study was done to compare the efficacy of NPWT with routine dressings in the treatment of chronic wounds in general.

2. Materials and Methods

Present study was done in a tertiary care hospital. The study protocol was approved by institutional ethics committee. The study period was from August 2015 to December 2017. Total 50 patients were included ulcer more than 3 weeks old and with all patients of 18 years and above. Ulcers of size more than 2x2x1 cm^3 and exclusion criteria included with fistulas, necrotic tissue in eschar, untreated osteomyelitis, malignancy in wounds, actively bleeding wounds, ischemic ulcers and burns.

Before beginning therapy, patients were explained about the study and after obtaining written consent were randomised by computer generated random number table into the two groups. A total of 50 patients of chronic ulcers were divided into 2 study groups according to ulcer characteristics: Vizstudy group of vacuum dressings (25 patients) and conventional dressing group (25 patients).

3. Methodology

Wounds of all the subjects in the study were compared according to wound characteristics and size. Size of the ulcer was measured in terms of volume of ulcer i.e., by multiplying greatest length with greatest width and depth.

In the study group foam material was applied under all aseptic precautions on the uler which was then covered by an airtight adhesive. A tube drain was put in the foam dressing on one side and the other end of tube was connected to the vacuum unit and negative pressure of 80-125 mm Hg was applied continuously for 3 days[8].

The control group was subjected to one saline dressing. Oral analgesics were given to all patients. They were also given standard empirical antibiotics to start with and then followed by antibiotics based on culture reports.

Dressings were done till the wounds closed spontaneously or by surgical intervention or until a period of 2-weeks, whichever was earlier. Blood sugar levels were regularly checked and controlled in the entire course of the study with help of appropriate doses of insulin.

3.1 Measurement of the Wound Dimensions (Clock Technique)[9]

In "clock technique", the length, width and depth of the wound is measured with the body imagined as a clock using a ruler.

The ruler was placed on the widest portion of the width from 3 to 9 o'clock. While measuring the length, the heels were positioned at 12 o'clock and toes at 6 o'clock. The wound depth was measured using a cotton applicator dipped in a normal saline solution to measure the deepest part of the wound bed. The applicator was removed and held against a ruler to give us the depth of the wound. At each follow up, appearance of granulation was noted, and wound dimensions were measured. Percentage of wound contraction was calculated for the index ulcer at each follow up.

3.2 Measurement of Perimeter and Granulation Tissue

The plastic cover of urine bag was split open and the sterile inner part was used to cover the ulcer. The outline of the ulcer was traced out over the cover an area of slough was marked. The cover was then placed on graph paper (with box size: 1 cm^2) and the entire drawing was retraced on graph for measurement. Perimeter was measured in centimeters by running length of a pliable string over the outline. The granulation tissue was calculated by subtracting area covered by slough from total area.
Treatment outcome was assessed in terms of:

- Percentage reduction of perimeter from the first to the fourteenth day of treatment.
- Percentage Wound contraction achieved at Day 3, 5, 8 and 14.
- Percentage increase of granulation tissue from the first to the fourteenth day of treatment.
- Days of Hospitalization.
- Final outcome - Wound healed by secondary intention or requirement of skin grafting.

4. Results

Average age of patients in study group was 53.6 years while in conventional dressing group it was 52.8 years.

Male to female ratio was high in both groups with 84% in conventional group and 80% males in the study group. Most common type of chronic ulcer observed in present study was traumatic ulcer (56%) followed by diabetic ulcer (22%), venous ulcers (18%) and pressure ulcers (4%).

Table 1. Comparison of appearance of granulation tissue in conventional v/s NPWT

Granulation Tissue	Group	Mean	SD	p-value
Baseline	Conv.	12.86	2.29	0.817
	VAC	12.50	2.45	
Week 2	Conv.	19.39	3.67	<0.01
	VAC	23.12	3.43	
Improvement (%)	Conv.	50.9%	12.7%	<0.01
	VAC	84.9%	11.2%	

At the end of 2 weeks, mean percentage improvement in granulation tissue in conventional group was 50.9% as compared to 84.9% in NPWT group (Table 1). Wound size was compared between the two treatment groups at baseline (329.3 *vs* 318 cm^3). Reduction in wound size was significantly faster with NPWT group with mean size at day 14 was 85.62 cm^3 in conventional group as compared to 31.86 cm^3 in NPWT group (Table 2).

Table 2. Comparison of wound size reduction in conventional v/s NPWT

Wound Size (cm3)	Group	Mean	SD	p-value
Baseline	Conv.	329.30	72.90	0.71
	VAC	318.60	56.40	
3rd Day	Conv.	217.34	67.40	0.51
	VAC	194.35	50.90	
5th Day	Conv.	177.82	43.30	< 0.05
	VAC	133.81	39.90	
8th Day	Conv.	128.43	37.60	< 0.05
	VAC	73.28	34.20	
14th Day	Conv.	85.62	29.80	< 0.05
	VAC	31.86	17.60	

The wound contraction rate was significantly faster with NPWT. The difference in the rate of wound contraction was apparent since 5th day and by the time of discharge/intervention, means percentage of wound contraction was 90.9% in study group and 74.54% in conventional group patients (Table 3).

Table 3. Comparison of wound contraction rate in conventional v/s NPWT

% age Wound Contracted	Group	Mean	SD	p-value
Day 3	Conv.	34.57	22.31	0.51
	VAC	39.56	19.87	
Day 5	Conv.	46.57	20.21	< 0.05
	VAC	58.76	18.12	
Day 8	Conv.	61.34	19.12	< 0.05
	VAC	77.69	16.83	
Day14	Conv.	74.54	17.94	< 0.05
	VAC	90.90	14.43	

By 2 weeks, mean reduction in perimeter in conventional group was 40% as compared to 61.6% in NPWT group (Table 4).

Table 4. Comparison of perimeter reduction in conventional v/s NPWT

Perimeter	Group	Mean	SD	p-value
Baseline	Conv.	32.32	5.59	0.27
	VAC	34.20	5.23	
Day 14	Conv.	19.39	3.67	<0.01
	VAC	13.12	3.43	
Improvement (%)	Conv.	40.0%	12.7%	<0.01
	VAC	61.6%	11.2%	

Table 5. Comparison of duration in hospital stay in conventional v/s NPWT

Hospital Stay	Group	Mean	SD	p-value
	Conv.	11.13	5.34	<0.05
	VAC	17.23	4.32	

Mean hospital stay was significantly more in cases managed by conventional dressing as compared to NPWT group (17.23 *vs* 11.13 days) (Table 5).

Closure by secondary intention was achieved in 92% and 80% patients of Conventional and NPWT group while skin grafting was required in 20% cases of conventional group and 8% cases in NPWT patients respectively.

5. Discussion

Negative Pressure Wound Therapy (NPWT) is now a day's being recommended as the treatment of choice for chronic ulcers. It changes the internal wound environment and lowers bacterial load, decreases collection in the wound and increases vascularity within the wound taking advantage of elasticity of periwound area. Vacuum dressings are nicely tolerated and are rapidly becoming the method of choice in wound dressings. But the results of various trials comparing it with conventional wound dressing had equivocal results. Hence, we decided to use NPWT for the management of chronic ulcers and compare its results with conventional dressing in terms of wound healing arte and hospital stay.

6. Demography

Average age of patients was 52.8 in study group as compared to 53.6 years in conventional group.

The incidence being higher age group can be well explained by fact that 2nd most of the chronic ulcers are diabetic ulcers, which is a complication of diabetes mellitus. Complications of diabetes increase with age. Also, diabetes is disease of mostly elderly. Similar findings of highest incidence being in age group of 45 to 64 years in the National Health Department Survey (NHDS) survey at USA[10]. In another similar study by Lone AM *et al.*, mean age in VAC group was 53.79 years and in Conventional group was 54.57 years[11].

Significant percentage of males was observed in both groups (84% in Conventional group and 80% in study group). This was similar to that observed in review of literature[12]. India being a male dominated country and lack of medical care given to females may also be a contributing factor. In a study by Lone AM et al. women constituted approximately one third and men around two third of study participant in a VAC and Conventional group[11].

7. Wound Characteristics

Subjecting the wound to negative pressure causes dilatation of micro vessels and increases local circulation there by encouraging angiogenesis and accelerating the growth of granulation tissue[13].

In study group patients the wound granulated earlier as compared to those treated by Conventional dressing. At the end of 2 weeks, mean percentage improvement in granulation tissue in conventional group was 50.9% as compared to 84.9% in VAC group. Wound contraction rate was significantly faster with VAC therapy. The difference in the rate of wound contraction was apparent since 5th day and by the 2nd week, mean percentage of wound contraction was 90.9% in Study group and 74.54% in conventional group patients ($p<0.05$).

Study showed that granulation tissue started appearing in 92.85% patients with vacuum dressings as compared to 53.57% patients with conventional dressings by end of 2 weeks[11]. Study concluded that vacuum dressings increased weight of granulation and wounds healed faster than saline gauze dressings[8]. VAC dressings reduced the volume of the ulcer and depth more significantly than saline dressings (59% *vs* 0% and 49% *vs* 8%, respectively). The study concluded that Negative pressure wound treatment may Speed up healing of large diabetic foot ulcers[14]. In a study it was observed that wound surface area decreased more rapidly with vacuum dressings[15].

Studied 60 patients with lower limb venous ulcers and showed wounds with NPWT healed faster as compared to normal saline dressings[16]. Studied NPWT in 20 patients with venous ulcers and concluded wound bed preparation was more rapid and integration of skin graft was also optimum in NPWT patients[17].

Showed[18] that mean percentage decrease in ulcer volume was greater in the NPWT group (51.8%) as compared to conventional dressings (42.1%). In[19] their study concluded that patients with pressure ulcers grades III and IV benefitted more with vacuum dressings as compared to saline dressings, in regard to rapid development of granulation tissue and wound contraction.

8. Hospital Stay

In present study, mean hospital stay was significantly more in cases managed by conventional dressing as compared to NPWT (17.23 *vs* 11.13 days; $p<0.05$). The decreased stay can be attributed to rapid healing and wound contraction rate in cases of NPWT group.

Demonstrated[15] that patients on vacuum therapy had shorter duration of hospital stay as: compared to conventional moist dressing. Retrospectively[20] analyzed 118 patients and showed that patients treated with vacuum dressings required lesser hospital stay than those treated with conventional dressings. In[21] their

literature review confirmed that NPWT helped in faster preparation of wounds, early grafting and lesser hospital stay. Study review[22] that use of NPWT helped in reducing the number of debridement's and hospital stay thereby decreasing the treatment cost to patients.

9. Wound Closure

Closure by secondary intention was achieved in 92% and 80% patients of Conventional and NPWT group while skin grafting was required in 20% cases of conventional group as compared to 8% cases in NPWT group respectively. As per the subjective assessment, good outcome was achieved in all the cases of NPWT as compared to 88% cases of conventional dressing. Outcome associated with the 3 (12%) cases of conventional group were due to delayed healing which subsequently required STSG. The difference was statistically non-significant.

In the study[11] most of the cases required skin grafting owing to large ulcers, the healing by secondary intention was higher in cases of VAC as compared to Conventional dressing (23% *vs* 7%). Our findings match those of[23] who demonstrated more cases required grafting in conventional group. In[24] their study on traumatic wounds, observed that requirement for skin grafting was less common in the NPWT group.

10. Conclusion

The study concluded that VAC appears to be superior compared to conventional dressings in the treatment of chronic wounds in terms of early appearance of granulation tissue, rapid contraction and decrease in hospital stay. The requirement of skin grafting was also less in VAC group.

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