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# Negative pressure assisted dressings: a game changer in wound care?

**Srinivas N.M.[1], Avinash Chandra Singh[1], Karan K. Shetty[1*]**

*Department of General Surgery, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India*

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## ABSTRACT

**Background:** Wounds and their management is the cardinal groundwork for a surgical practice. Wound management has been an ever evolving field. The methods we employ currently are nowhere close to the time of inception of wound management. Negative pressure–assisted wound closure has brought a significant change in the management of wounds and has also improved the overall outcome. The present study is conducted to assess the efficacy of topical negative pressure moist wound dressing as compared to conventional moist wound dressings in revamping the healing process in chronic wounds and ulcers. **Methods:** A prospective randomised control study consisting 100 patients for the treatment of chronic wounds. They were randomly divided into two groups i.e. topical negative pressure moist dressing group and moist saline dressing for their wound. Follow up of wound was done in all cases and wound assessed depending on wound size, wound bed score, % of granulation tissue cover on first and second week for both the wound dressings group and a comparison was made between the two. **Results:** The most common cause of the ulcer was secondary to diabetes ( 42%).The percentage reduction of percentage of wound in the study group ( 19.52 ± 7.67), the mean difference in wound bed score and the percentage of granulation tissue formation ( 81.0 ±8.29) in the study group( 9.60 ±2.16) between presentation and subsequent follow-ups were statistically significant. **Conclusions:** The topical negative pressure dressing group was better in every way when compared to the conventional wound dressing group. It was also seen it is cost effective and overall hospital stay is less. It has and probably will continue to be a major influencer in the field of wound care.

**Keywords:** Wound care, negative pressure assisted dressings, vacuum assisted closure, wound bed score, chronic wounds, saline dressing.

## Introduction

Wounds and their management is the cardinal groundwork for a surgical practice. A wound is a break in the integrity of the skin or tissues often, which may be associated with disruption in the normal anatomical structure and function[1]. A surgeon s role in case of wound healing has always been to bring the wound environment as close as possible to normal, so that the natural healing process can take its course. This can be achieved by removing the infective foci and repairing or clearing off damaged structures. Wound repair is the effort of injured tissues to restore their normal function and structural integrity after injury.

**Correspondence*

**Dr.Karan K Shetty**

Department of General Surgery, Bangalore Medical College & Research Institute, Bangalore, Karnataka, India.

**E Mail:** drkarankshettyyk@gmail.com

In an effort to restore barriers to fluid loss and infection, re-establish normal blood and lymphatic flow patterns and restore the mechanical integrity of the injured system, an unblemished repair is often sacrificed for the need to return to function. Wound management has been an ever evolving field. The methods we employ currently are nowhere close to the time of inception of wound management. In the past 15 years there have been significant advances in complex acute and chronic wound management. One of the one of the most significant discoveries was the improvement in wounds with negative pressure–assisted wound closure. This has brought a significant change in the management of wounds and has also improved the overall outcome.

Clinical benefits of negative pressure therapy have been demonstrated in randomized control trails and case-control studies. These benefits include decrease in wound volume or size, accelerated wound bed preparation, accelerated wound healing, improved rate

of graft take, decreased drainage time for acute wounds, reduction of complications, enhancement of response to first line treatment, increased patient survival and decreased cost[2].Application of a sub atmospheric pressure in a controlled manner to the wound site has got an consequential role in wound healing. The present study is conducted to assess the efficacy of topical negative pressure moist wound dressing as compared to conventional moist wound dressings in revamping the healing process in chronic wounds and ulcers and to prove that negative pressure dressings can much better treatment option in the management of acute and chronic wounds. We aim to determine the efficacy of wound healing in terms of:

- Quality of wound healing in both assessed by wound Bed Score.
- Rate of granulation tissue formation as percentage of ulcer surface area
- Reduction of surface area of wound
- Cost effectiveness and Duration.

**Literature survey**

The concept of recorded wound care goes back to circa 2200 BC, when "three healing gestures" were chiselled into the famous Sumerian clay tablet: washing the wound with beer and hot water, making plasters (mixtures of herbs, ointments, and oils), and bandaging the wound[3].Ancient Egyptian treatment for open wounds using a paste of grease, honey and lint, is documented in papyruses dating back to 1400 BC. Hippocrates (*circa* 400BC) detailed the importance of draining pus from the wound, and Galen described the principle of first and second intention healing[4].The Greeks, classified wounds as acute or chronic in nature. Galen of Pergamum (120 – 201 A.D.), appointed as the doctors to the roman gladiators, emphasized the importance of maintaining a moist environment to adequate healing. It was shown later that epithelialization rate increases by 50 % in a moist wound environment when compared to a dry wound environment. Joseph Lister (1827-1912) probably made one of the most significant contribution to wound healing. He is credited as developing the first antiseptic dressing in 1867 by soaking lint and gauze in carbolic acid[4].After attending an impressive lecture by Lister in 1876, Robert Wood Johnson (American industrialist and co-founder of company Johnson & Johnson) began 10 years of research that ultimately resulted in the mass production of an antiseptic dressing in the form of cotton gauze impregnated with iodoform.Polymeric dressings were developed in the 1960s and 1970s. The discovery of cytokines and growth factors in the 1950s opened a new age in wound healing research. The original description of negative pressure-assisted wound therapy (NPWT) was presented by Argenta and associates in 1997.

**Negative pressure assisted wound closure**

The original description of negative pressure-assisted wound therapy (NPWT) was presented by Argenta and associates in 1997 and was hypothesized that there is a fivefold increase in blood flow to cutaneous tissues. There have been reports of a 78% decrease in hospital stay and a 76% decrease in cost with negative pressure-assisted therapy. NPWT can be used for acute, subacute and chronic wounds and results in removal of wound exudates while keeping the wound moist. In addition, treatment with negative pressure results in faster healing times with fewer associated complications and significant improvement in wound depth in chronic wounds. The practice of exposing a wound to sub-atmospheric pressure for an extended period to promote debridement and healing was first described by Fleischmann *et al* in 1993,following the successful use of this technique in 15 patients with open fractures[5]Further success with topical negative pressure treatment in Germany was reported by Muller following the treatment of 300 patients with infected wounds, and in1998 Kovacs *et Al* described how 'vacuum sealing' could be used for the treatment ofchronic radiation ulcers[6].A series of basic animal studies conducted by Morykwas MJ, Argenta LC ,using a new sub atmospheric pressure technique (V.A.C.) showed four-fold increase in blood flow levels to the wounds at 125mmHg. This was then followed by a study where 300 wounds were treated by Argenta LC, Morykwas. Two hundred ninety-sixwounds responded favourably to subatmospheric pressure treatment, with an increased rate of granulation tissue formation[7].Application of a controlled vacuum to the wound interface facilitates removal of excess interstitial fluid because of increased pressure gradients. This physically results in a decrease in interstitial pressure. When the interstitial pressure falls below capillary pressure, the capillaries reopen and flow to the periwound tissue is restored. This also leads to decrease in bacterial load due to increased blood flow, thereby creating a suitable bed for graft or flap cover[8].Complications of VAC dressing include Toxic Shock Syndrome(TSS), bleeding and other wound complications.

**Methodology**

This prospective randomised control study included 100 patients admitted in Victoria Hospital and Bowring and Lady Curzon hospital, affiliated to Bangalore Medical College and Research Institute, under the Department of General Surgery for the treatment of

chronic wounds. The study period extended from June 2016 to December 2017. 50 patients were taken randomly into the test group i.e. topical negative pressure moist dressing group whereas the control group consisted of 50 randomly selected patients who received moist saline dressing for their wound.

The range of patients included chronic wounds. However, patients with fistulas, osteomyelitis, malignancy and active bleeding from wound were excluded from the study.

Detailed history of the patient, along with thorough clinical examination of the patient was done. Routine investigations and work up was done as per the department protocols. The wounds were thoroughly debrided and the ulcer dimensions as well as the surface are assessed and depicted on the graphs before dressings were applied for both groups. Follow up of wound was done in all cases and wound assessed depending on wound size, wound bed score, % of granulation tissue cover on first and second week for both the wound dressings group. Wound characteristics were observed after second week with regard to the:

1. Wound bed score and increase in wound bed score.
2. Wound size and percentage of reduction of wound size
3. Percentage of granulation tissue cover
4. Percentage of graft take up.

Dressings were done 2-4 days apart for each patient depending upon amount of wound discharge for both the groups.

**Statistical methods:** Unpaired students "t" test and paired "t" test were used to find out the statistical significance. A 'P' value < 0.05 was taken as significant.

**Results**

100 patients were taken in this study and randomly divided into two equal and comparable groups. The test or study group included 50 patients subjected to topical negative pressure dressing and the rest were in the control group who underwent conventional wound dressings. In this study the age of the patients ranged from 10 yrs to 79 yrs. 64% of patients included in this study were above 41 years of age. The mean age of study group was 43.56 ± 17.94 years and the mean age of control group was 49.60 ± 14.90 years. Out of the 100 patients included in this study, 24 were females and the male to female ratio was 19:6.This study was inclusive of ulcers due to various etiology. The most common cause of the ulcer was secondary to diabetes( 42%). This was followed by post infective raw areas (32%). (Table 1).

**Table 1: Type of ulcer with group wise distribution**

| Type of ulcer | Study group | % | Control group | % |
|---|---|---|---|---|
| Diabetic | 14 | 28 | 28 | 56 |
| Post infective raw area | 14 | 28 | 18 | 36 |
| Traumatic ulcer | 18 | 36 | 4 | 8 |
| Venous ulcer | 4 | 8 | 0 | 0 |
| Total | 50 | 100 | 50 | 100 |

The mean duration of no of days of hospital stay in the study group is 42.36 ± 13.78and 46.76 ±28.36 in the control group with a p value is 0.4887.The wound size at initial presentation in the study group is 107.07±87.23 and in the control group is 89.19 ±81.72, this is found to be statistically insignificant (p value=0.2514) thus implying the comparability of wound size at initial presentation. Similarly the wound size after the completion of treatment inthe study group is 89.79 ±81.73 and in the control group is 82.99 ±73.71 which is also found to be statistically insignificant p value. (p value=0.4822).The mean difference in wound size in the study group is 17.88±9.70and in control group is 6.79 ± 9.09 ,which shows, the difference is statistically significant ( p value = 0.0001 ).

**Table 2: Comparison of the study and control groups with respect to wound size(in cm2)before and after treatment and their difference.**

| Treatment | Groups | Mean | Sd | P-value |
|---|---|---|---|---|
| Before | Study | 107.07 | 87.23 | 0.458 |
| | Control | 89.19 | 87.12 | |
| After | Study | 89.79 | 87.23 | 0.759 |

| | | | | |
|---|---|---|---|---|
| | Control | 82.99 | 73.71 | |
| Difference | Study | 17.88 | 9.70 | 0.0001 |
| | Control | 6.79 | 9.09 | |

P<0.05

Mean reduction in the size of wound was more in the study group than the control group. The percentage reduction in the study group is 19.52± 7.67 and 6.64 ±7.27 in the control group which is statistically significant.

**Table 3: Comparison of the study and control groups with respect to % reduction in wound size by t test.**

| GROUPS | n | MEAN | SD | t- value | p-value |
|---|---|---|---|---|---|
| STUDY | 50 | 19.52 | 7.67 | 6.0943 | 0.00001 |
| CONTROL | 50 | 6.64 | 7.27 | | |

The wound bed score at initial presentation in the study group is 5.52 ±2.42 and in the control group is 5.08 ± 1.44, this is found to be statistically insignificant (p-value=0.4382) thus implying that the wound bed score at presentation can be compared. However, the wound bed score after the completion of the treatment in the study group is 15.12 ±1.54 and in the control group is 10.20 ±2.69 which is statistically significant. The mean difference in wound bed score in the study group is 9.60 ±2.16and the control group is 5.12 ±1.99, the difference is statistically significant ( p-value = 0.0001 ).

**Table 4: Comparison of the study and the control groups with respect to wound bed scores, before and after treatment and their difference by unpaired t test**

| Treatment | Groups | Mean | Sd | T-value | P-value |
|---|---|---|---|---|---|
| Before | Study | 5.52 | 2.42 | 0.7817 | 4.382 |
| | Control | 5.08 | 1.44 | | |
| After | Study | 15.12 | 1.54 | 7.9335 | 0.00001 |
| | Control | 10,2 | 2.69 | | |
| Difference | Study | 9.60 | 2.16 | 7.6339 | 0.00001 |
| | Control | 5.12 | 1.99 | | |

The % of granulation tissue formation in the study group is 81.0 ±8.29 and inthe control group is 53.60 ± 19.23 , which is found to be statistically significant (p-value=0.00001).

| Groups | Mean | Sd | T-value | P-value |
|---|---|---|---|---|
| Study | 81.00% | 8.29 | 6.5418 | 0.00001 |
| Control | 53.60% | 19.23 | | |

**Discussion**

This study was done as a prospective randomized controlled comparative study to compare the efficacy of topical negative pressure dressing to conventional moist wound dressings in the healing of wounds.

The mean age in our study is 43.56 and 49.6 in the study and control group respectively which is comparable to other studies like those done by Tauro et al and Joseph et al[9,10]Patients in our present study were suffering from ulcers of varied etiology,most common etiology was diabetic, next most common was infective etiology. In a study done by Tauro et al also the main etiology was diabetic ulcer but next most common cause waspressure ulcer and in our present study there was no ischemic ulcer and pressure ulcer[9]In our study the mean difference of the reduction in the wound size between the study and test group was statistically significant. Also, the percentage of reduction of the wound size between the two groups was statistically significant. In a study done by Prabhdeep. S. N et al, showed a lesser mean reduction in wound size (16.14%) when compared to our studywhereas a study done by Nather et all showed higher % of reduction inwound size ( 32.8 %) compare to present study (25.57%) in patients who received VAC dressings[11,12]In our study the percentage of granulation tissue cover in the study group (81.56%) and the control group (54.30%) is comparable to the study done by Joseph et al[10] However the study done by Tauro et al showed lesser percentage of granulation tissue cover (71.43%) when compared to our study.Though the mean duration of hospital stay is statistically not significant, it is less in study group

compare to control group. Number of dressings were less in the topical negative pressure dressing group hence reducing the cost of dressing when compared to conventional wound dressings group.

Chronic non healing wounds pose a continual challenge in medicine, since the treatment is doctor dependent and there are no fixed protocols. Despite advances in conservative and surgical wound care management, such as flap surgery, split thickness skin grafts, hydrocolloid dressings, iodine based gels and recombinant human platelet derived growth factor, chronic wounds continue to plague a huge population causing signi9ficant morbidity and decrease in the quality of life. The use of sub atmospheric pressure in topical dressings to treat complications such as dehiscence or infection has been extremely satisfying. Such complications usually prolong hospitalization and the patient usually ends up debilitated. Treatment with the vaccum assisted closure device allows many of these patients to be discharged from the hospital and treated at home on a much less costs.

Our study shows:

1. Significant increase in wound bed score in topical negative pressure dressing group when compared to conventional wound dressing group.
2. Increased rate of granulation tissue formation in the topical negative pressure dressing group when compared to the conventional wound dressing group.
3. Significant reduction in wound size in the topical negative pressure dressing group when compared to conventional wound dressing group.
4. Duration and cost of hospital stay is reduced in the topical negative pressure dressing group when compared to conventional wound dressing group.

There is a future scope of study in larger populations and taking into account various factors that slow the healing process. Also, a study of role of live cell scaffolds, stem cell therapy and gene therapy will be a very enigmatic field to dive in.

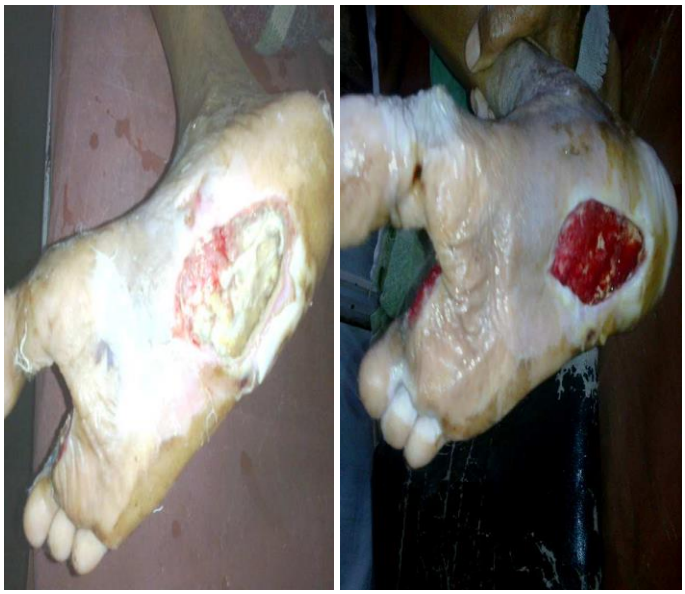

**Fig 1: before** **after**

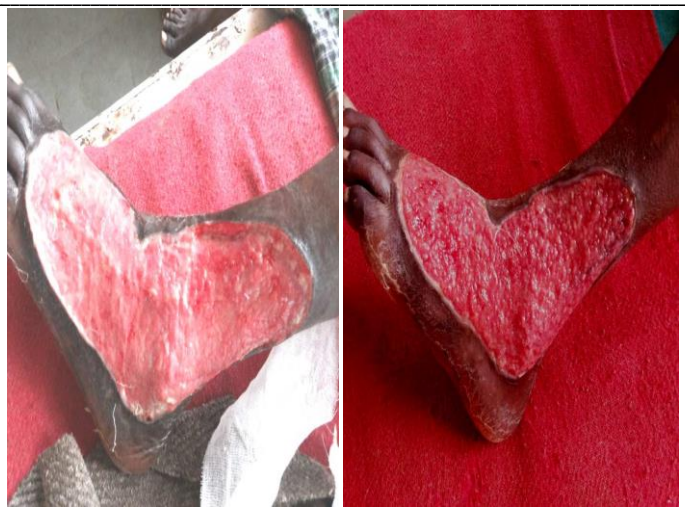

**Fig 2: before** **after**

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