ORIGINAL RESEARCH

Infected chronic wounds, what is the better option: Conventional dressing or negative pressure wound therapy?

[1]Ashutosh Kumar, [2]Manish

[1]Assistant Professor, [2]Professor, Department of General Surgery, RDJM Medical College, Muzaffarpur, Bihar, India

Corresponding Author
Ashutosh Kumar
Assistant Professor, Department of General Surgery, RDJM Medical College, Muzaffarpur, Bihar, India

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ABSTRACT

Aim: The aim of the present study was to compare the effectiveness of negative pressure wound therapy with conventional dressings in the healing of infected chronic wounds.

Material & Methods: The Present study was single-center, open labelled randomised control trial conducted in the Department of General Surgery and the study duration was of 36 months. 200 patients with chronic ulcers were randomly divided in two groups of 100 each as Group A (Negative Pressure Wound Therapy) and Group B (Conventional Dressing).

Results: Participants in the study had an average age of 54.66 ± 12.8 years for the Conventional group and 53.7 ± 14.6 years for the NPWT group. No difference was statistically significant. Males dominated the traditional (65%) and NPWT (55%) groups. No difference was statistically significant. The present study indicated that 65% of chronic ulcers were diabetic, 25% venous, and 10% pressure. 95% of NPWT patients at 2 weeks and 55% of conventional group cases at 1 week developed granulation tissue, compared to 20% and 65% of conventional group cases. A statistical test showed a significant difference (p<0.01). Granulation tissue formed in 96% of NPWT patients and 86% of conventional cases after 3 weeks. NPWT accelerated wound contraction. In the first week, the wound healed unevenly. Disparity was detectable statistically (p<0.05). NPWT patients reduced wound size faster than typical patients. Starting in week 2, the difference was statistically significant (p<0.05). Although 88% of NPWT patients achieved closure with secondary aim, 72% of conventional patients and 12% of NPWT patients required skin grafting (p<0.05).

Conclusion: The modified negative pressure wound treatment seems to be more effective than the usual dressing in early granulation tissue appearance, rapid contraction, faster healing, shorter hospital stays, and reduced expenses.

Key words: Infected chronic wounds,negative pressure wound therapy, conventional dressing, granulation tissue

INTRODUCTION

Wounds that do not heal after receiving initial treatment or that continue to worsen despite adequate care are known as refractory wounds, and they have a significant impact on patients' quality of life and the cost to the healthcare system.[1,2] Refractory wounds may occur for many different reasons, including vascular insufficiency, bacterial presence in wounds, absence of growth factors for healing, and many more.[3,4] Cell failure is a known contributor to refractory wounds; furthermore, keratinocytes' migration and response to growth stimuli are impaired in the vicinity of refractory wounds, which makes their formation more likely.[5] Refractory wounds in clinical practice need a multidisciplinary approach that includes surgical procedures, dressing changes, anti-infection medication, and primary disease treatment.[6-8]

Despite the fact that these treatments have the potential to heal most resistant wounds, patients still have to deal with the associated issues, such as a lengthy illness course, unpleasant experience, and substantial financial load.[9,10] NPWT was first created to meet the needs of plastic and reconstructive surgery patients.[11,12] The process of NPWT involves a specialised pump that is linked to a solid foam that is both robust and open-celled, and the transmission of sub-atmospheric pressure, either intermittently or continuously. To maintain a contained environment, a semipermeable membrane covers the solid foam, and a canister attached to the pump collects the wound exudate.[13]

One relatively new non-invasive adjunctive therapy system is Negative Pressure Wound Therapy (NPWT). This system uses a Vacuum-Assisted Closure device (VAC) to withdraw fluid from open

wounds through a sealed dressing and tubing that is connected to a collection container. The goal is to speed up the healing process. One proven method to speed up the healing process of different types of wounds is to utilise sub-atmospheric pressure dressings, which may be purchased as a VAC device.[14-16]

The purpose of this research was to evaluate the efficacy of standard dressings vs negative pressure wound care for the treatment of infected chronic wounds.

MATERIAL & METHODS

The present investigation was a single-center, open-label randomised controlled trial done in the Department of General Surgery. The study length was 36 months. A total of 200 patients suffering from chronic ulcers were randomly allocated into two groups, with 100 patients in each group. Group A received Negative Pressure Wound Therapy, whereas Group B received Conventional Dressing.

Patients admitted to our hospital in surgery ward with infected chronic wounds due to diabetic ulcers, pressure ulcers, venous ulcers and pilonidal sinus ulcers willing to participate, were considered for study.

METHODOLOGY

All patients had a comprehensive evaluation, including a thorough medical history, clinical examination, and appropriate diagnostic tests. The Index ulcer was defined as the ulcer with the greatest surface area and a minimum period of three months at the time of inclusion. The size of the Index ulcer was assessed by calculating its volume, which was obtained by multiplying the largest length, breadth, and depth of the wound. Patients were provided with an explanation of the study and were required to provide written informed permission in order to participate and be followed up. The patients were randomly allocated into two groups using computer-generated numbers.

- **GROUP A:** (Negative Pressure Wound Therapy).
- **GROUP B:**(Conventional Dressing).

All patients included in the research had severe surgical debridement of their wounds initially and during subsequent dressing changes to eliminate necrotic tissue and slough. Following debridement in the emergency operating room, a foam-based dressing was placed to the wounds of the patients in the research group using strict aseptic techniques. Group A patients used an adhesive drape to establish an airtight seal over the dressing. A vacuum was attached to an evacuation tube that was imbedded in the foam. Sub-atmospheric pressure, ranging from 80 to 125 mmHg, was continuously maintained for a duration of 5 days. Group-B was given a daily treatment of gauze soaked in saline solution. All patients received oral analgesics when their dressings were changed. All patients received standard antibiotic regimens, which originally included broad-spectrum antibiotics and were subsequently adjusted based on the culture sensitivity data. The ulcers were managed until the wound healed naturally, via surgery, or until the end of the 3-week period, whichever occurred first. During the therapy, blood glucose levels were closely monitored and regulated with the administration of precise amounts of insulin. The evaluation of treatment result was conducted at week 1, 2, and 3, focusing on the presence of granulation tissue, the extent of wound contraction accomplished at the end of each week, the measurement of wound surface area, the duration of hospitalisation, and the cost of the procedure.

STATISTICAL ANALYSIS

The data was gathered and organised using Microsoft Excel, and then analysed using the SPSS 23.0 software. The continuous variables were analysed by calculating their frequency, percentage, averages, and standard deviations (SD). On the other hand, the categorical variables were analysed by calculating their ratios and proportions. The chi-square test or Fisher exact test, if appropriate, were used to assess the difference in proportions between qualitative variables. A P value below 0.5 was deemed statistically significant.

RESULTS

Table 1: Age and gender distribution

Characteristic	Group A (NWPT)	Group B (Conventional)	Total
Age (in years)			
≤ 50	66 (66%)	72 (72%)	138 (69%)
>50	34 (34%)	28 (28%)	62 (31%)
Mean	54.66 ± 12.8	53.7 ± 14.6	54.36 ± 12.8
Gender			
Female	45 (45%)	35 (35%)	80 (40%)
Male	55 (55%)	65 (65%)	120 (60%)

Mean age of study subjects was 54.66 ± 12.8 and 53.7 ± 14.6 years in Conventional and NPWT group respectively. The difference was statistically non-significant. Male Preponderance was observed in both groups (65% in Conventional and 55% in NPWT group respectively). The difference was statistically non-significant.

Table 2: Type of ulcer and granulation tissue appearance

Type of ulcer	Group A (NWPT)	Group B (Conventional)	Total
Diabetic ulcer	65 (65%)	69 (69%)	134 (67%)
Pressure ulcer	10 (10%)	11 (11%)	21 (10.5%)
Venous ulcer	25 (25%)	20 (20%)	45 (22.5%)
Granulation tissue appearance			
Week 1	55 (55%)	20 (20%)	75 (37.5%)
Week 2	95 (95%)	65 (65%)	160 (80%)
Week 3	96 (96%)	86 (90%)	182 (91%)

Most common type of chronic ulcer observed in present study was diabetic ulcer (65%) followed by venous ulcers (25%) and pressure ulcers (10%). No difference was seen in the study groups on the basis of type of ulcer. At the end of 1 and 2 weeks, 55% and 95% cases of NPWT group had granulation tissue as compared to only 20% and 65% cases in conventional group. The difference was statistically significant (p<0.01). By the end of 3 weeks, 96% of the cases in NPWT group had granulation tissue as compared to 86% cases in conventional group.

Table 3: Wound contraction rate and surface area

Wound contraction	Group A (NWPT)	Group B (Conventional)	P Value
Week 1	58.72 ± 15.12	47.56 ± 22.18	< 0.05
Week 2	77.63 ± 17.83	63.37 ± 18.12	< 0.05
Week 3	91.86 ± 15.45	76.64 ± 16.94	< 0.05
Wound surface area (cm2)			
After debridement	144.96 ± 16.14	142.58 ± 20.24	0.78
Week 1	86.54 ± 17.13	116.54 ± 20.22	0.36
Week 2	53.77 ± 14.86	74.36 ± 18.12	< 0.05
Week 3	26.34 ± 15.45	44.26 ± 18.93	< 0.05

The wound contraction rate was significantly faster with NPWT therapy. The difference in the rate of wound contraction was apparent since 1stweek. The difference was statistically significant (p<0.05). Decrease in wound dimensions was significantly faster in NPWT group patients as compared to conventional group. The difference was statistically significant from week 2 (p<0.05).

Table 4: Wound closure

Wound closure	Group A (NWPT)	Group B (Conventional)	Total	p-value
Secondary intension	72 (72%)	88 (88%)	160 (80%)	< 0.01
STSG	28 (28%)	12 (12%)	40 (20%)	< 0.01

Closure by secondary intention was achieved in 88% and 72% patients of NPWT and Conventional group while skin grafting was required in 12% cases of NPWT group as compared to 28% cases in conventional group respectively (p<0.05).

Table 5: Other characteristics

Characteristics	Group A (NWPT)	Group B (Conventional)	p-value
Healing time (days)	7.45 ± 2.06	12.18 ± 4.56	< 0.01
Hospital stay (days)	13.17 ± 4.36	19.21 ± 6.34	< 0.05

Mean healing time in days was significantly less in cases managed by NPWT compared to conventional group. Mean hospital stay was significantly more in cases managed by conventional dressing as compared to NPWT.

DISCUSSION

Negative pressure wound therapy (NPWT) or vacuum aided closure (VAC) treatment involves the application of uniform local negative pressure to the surface of the wound.[17,18] An independent wound dressing (made of polyurethane or polyvinyl alcohol) is applied to the exposed wound, together with a hermetically sealed film. The wound dressing is linked to a control unit by a series of suction tubes, allowing for the adjustment of the principal negative pressure applied to the wound's surface.[19] Negative-pressure wound treatment (NPWT) prevents fluid buildup at wound sites by continuously draining it, eliminating the need for daily dressing changes. It also enhances regional blood flow and decreases bacterial growth, hence minimising the risk of infection. NPWT at the cellular level promotes collagen production, angiogenesis, and the development of

granulation tissue.[20-22] Regrettably, the use of NPWT with polyurethane foam is mostly restricted to wounds that have managed infection after operations like necrotic tissue debridement.

The average age of the research participants was 54.66 ± 12.8 years in the Conventional group and 53.7 ± 14.6 years in the NPWT group. The observed change did not reach statistical significance. Both the Conventional and NPWT groups had a higher proportion of males, with 65% in the Conventional group and 55% in the NPWT group. The observed change did not reach statistical significance. The predominant chronic ulcer type identified in the current investigation was diabetic ulcer (68%), followed by venous ulcers (20%) and pressure ulcers (12%). The research groups did not exhibit any discernible variation based on the kind of ulcer. The incidence of diabetes-related complications rises as individuals age. Diabetes mostly affects the older population. The national health department survey (N.H.D.S) in the USA revealed that the age range of 45 to 64 years had the greatest incidence of diabetic ulcers.[23] The predominant chronic ulcer type identified in the current investigation was diabetic ulcer, accounting for 65% of cases, followed by venous ulcers at 25% and pressure ulcers at 10%. The research groups did not exhibit any variation based on the kind of ulcer. After 1 and 2 weeks, the NPWT group had granulation tissue in 55% and 95% of instances, respectively, whereas the conventional group only had granulation tissue in 20% and 65% of cases. The disparity exhibited statistical significance ($p<0.01$). At the conclusion of a 3-week period, the NPWT group had granulation tissue in 96% of instances, whereas the conventional group showed granulation tissue in 86% of cases. According to research conducted by Lone AM *et al*.[23], 92.85% of patients in the NPWT group developed granulation tissue at the end of Week 2, compared to just 53.57% of patients in the traditional group. Armstrong and Lavery[24] noted that negative pressure treatment led to a higher incidence of granulation tissue development and a greater percentage of cured wounds compared to saline gauze dressings. Eginton MT *et al*.[25] conducted a comparison of the rate of wound healing using Negative Pressure Wound Therapy (NPWT) and standard moist dressings for the treatment of extensive diabetic foot lesions. Non-pressurized wound therapy (NPWT) dressings shown a considerably greater reduction in both wound volume and depth compared to wet gauze dressings (59% vs. 0% and 49% vs. 8%, respectively).

The rate of wound contraction was notably accelerated by NPWT treatment. The disparity in the pace of wound contraction became evident from the first week. The observed difference exhibited statistical significance at a level of $p<0.05$. Patients in the NPWT group saw a considerably quicker reduction in wound size compared to those in the traditional group. The disparity was statistically significant starting from week 2 ($p<0.05$). Secondary intention closure was successfully accomplished in 88% and 72% of patients in the NPWT and Conventional groups, respectively. However, skin grafting was necessary in 12% of instances in the NPWT group, compared to 28% in the conventional group ($p<0.05$). The research conducted by Moues CM *et al*.[26] study comprised 29 patients receiving NPWT vacuum treatment and 25 patients receiving conventional treatment. The researchers saw a substantial acceleration in the reduction of wound surface area while using NPWT vacuum treatment. The mean duration of healing, measured in days, was considerably shorter in patients treated with NPWT compared to the conventional group (7.43 days vs 12.18 days; $p<0.01$). The average duration of hospitalisation was substantially longer in patients treated with traditional dressing compared to those treated with NPWT (18.22 vs 12.16 days; $p<0.05$). Ford *et al*.[27] observed that the NPWT group had a larger average percentage decrease in ulcer volume compared to the control group (51.8% vs. 42.1%, $p=0.46$). Additionally, NPT facilitates healing and the formation of new blood vessels. Ashby *et al*.[28] observed that NPWT had significant advantages over wet dressing in terms of promoting accelerated formation of granulation tissue and wound contraction. The average duration of healing, measured in days, was considerably shorter in instances treated with NPWT compared to the conventional group. The average duration of hospitalisation was substantially longer in patients treated with traditional dressing compared to NPWT. Wound therapy is the primary treatment for managing persistent wounds. We suggest doing more research with a larger sample size to confirm our findings in each distinct category of chronic wounds, namely venous, diabetic, and pressure ulcers.

CONCLUSION

The current research determined that Negative Pressure Wound Therapy, together with its modification, demonstrates superiority over standard dressing in terms of early granulation tissue formation, quick wound contraction, accelerated healing, reduced hospitalisation duration, and enhanced cost-effectiveness.

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