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A comparative study on the effectiveness of negative pressure wound therapy versus conventional dressing in patients post skin grafting procedure

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Abstract

An essential biological layer for hemostasis is the skin surface. Therefore, it is crucial to restore the skin surface, even while the restoration of the underlying tissues can wait. By restoring collagen, providing biological occlusion, and protecting the wound, skin grafts aid wound healing and are an important technique to improve the prognosis. Since negative pressure wound therapy (NPWT) has been increasingly used in the health care sector for the management of different kinds of wounds by applying negative pressure to the wound bed, this cutting edge therapy can hasten the healing of both acute and chronic wounds. In this pragmatic approach, the present study was carried out at Vydehi Institute of Medical Sciences & Research Centre's Department of General Surgery, Bangalore, between (2018 and 2020). A total of 48 patients were included in this study, and we categorised them into two groups: Group 1 was the conventional group, and Group 2 was the NPWT. The data was collected and analyzed using SAS software. As per the findings, males comprise 30 (62.5%) and females 18 (37.5%), with a mean age of 48.96 +/-11.64 years in the conventional group and 47.67 +/- 13.12 years in the NPWT group. Most of the ulcers were located in the foot (39.58%). Graft uptake was more superior in patients who received NPWT (95.83%) when compared to the conventional group, showing a significant difference ($p < 0.001$). All 24 patients in the NPWT group had no complications or further requirement for revision surgery, whereas 6 patients in the conventional group (25%) required revision surgery due to postoperative complications. The mean duration of hospital stay was shorter in patients in the NPWT group (11.38 +/- 1.06 days) when compared to the Conventional group (18.54 +/- 3.01 days), with a significant difference ($p < 0.001$). According to the study findings, the use of sub-atmospheric pressure dressings in the form of vacuum assisted closure has been demonstrated to be a potential method of treatment for treating wounds and enhancing the results of skin grafting, especially in patients who have had skin grafting.

Keywords: SSG-Split skin grafting; NPWT-Negative pressure wound therapy; VAS-Vacuum Assisted Closure

1. Introduction

The surface of the skin is important as a biological layer for hemostasis.^{1,2} Restoring the skin surface is therefore critical, even if underlying structures can await later reconstruction. Skin grafting is a technique used for transplanting skin from one area (the donor site) to the required defective area (the recipient site).^{2,3} Wounds requiring reconstruction are usually large with extensive soft-tissue loss caused by trauma, infections, burns, diabetic foot ulcers, pressure sores, etc. These situations often lead to considerable distress for the patients and have a negative impact on the physical, emotional, social, and economic aspects of their lives.² Skin grafts assist wound healing by replacing collagen and providing biological occlusion and protection of the wound.³ One of the principal tools of a surgeon is the split-thickness skin graft (STSG), which is a simple yet versatile technique for reconstruction of cutaneous defects. The major causes of skin graft loss are the formation of blisters or hematomas under the graft, which interfere directly with serum imbibition and revascularization; a lack of proper apposition of the graft to its bed; and infection of the graft. Thus, further

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interventions are required for successful coverage of such wounds. Negative pressure wound therapy (NPWT), also known as topical negative pressure therapy, has been increasingly used in health care for the management of a wide variety of wounds over the last 2–3 decades. It is an advanced therapy that can be helpful to accelerate wound healing in both acute and chronic wounds by delivering negative pressure (suction) to the wound bed.⁵ As negative pressure wound therapy secures bolster and increases perfusion, it is used in treatment for complex anatomical sites.⁶ The current study aims to determine the feasibility and safety of negative pressure on wound therapy, as well as the relationship between the length of graft take-up and hospital stay. It also seeks to understand the impact of negative pressure wound therapy on postoperative outcomes from skin grafts.

2. Material and methods

2.1. Source of data

All the patients with acute or chronic ulcer cases were admitted to the general surgery ward at the Vydehi Institute of Medical Sciences and Research Centre, Bangalore. The study was conducted from November 2018 to October 2020. The Data was collected from a case Proforma pertaining to the patient's particulars, history, clinical examinations, investigations, diagnosis, and surgical procedures. The following inclusion and exclusion criteria were considered for the study's inclusion

- Willing and consented patients with
- Acute and sub-acute wounds, including traumatic
- Pressure sores
- Venous ulcers and exclusion; diabetic ulcers
- Post-operative wound dehiscence and chronic wounds were included and

Exclusion criteria were

- Deep-seated ulcers;
- Infected ulcers;
- Paediatric age group;
- Malignant ulcers;
- Untreated osteomyelitis; and
- Patients with ulcers not consenting to the study and follow-up.

2.2. Operative Methods

The patients were divided into two groups: the conventional group, wherein they underwent SSG followed by normal gauze dressing. The other group was the NPWT group, wherein the patients underwent SSG followed by NPWT application. Wounds were assessed on postoperative day at 5. Patients were allotted to each group by using randomization techniques.

2.3. NPWT Procedure

After receiving spinal anaesthesia, the patient was put in the supine posture. The wound's recipient area underwent thorough debridement. The donor area was chosen for a split-thickness skin graft based on the size of the wound. In order to cover the entire wound region, fenestrations produced for the harvested graft were gently placed over the recipient area. graft fastened to the wound by staples or sutures. The tip of a 16 F Ryle tube was removed. Along a short section of the tube, several tiny holes were drilled. A sterile sponge was taken corresponding to the size of the wound, and the Ryle's tube was inserted from one end and brought out to the opposite end to prevent tube displacement by patient movement. A medicated tulle dressing was placed over the skin graft. The sterile sponge with Ryle's tube was placed over this dressing. The entire wound with the sterile sponge was further covered with Opsite so as to create an airtight compartment for the negative suction to act. The end of Ryle's tube was connected to a suction apparatus, and leaks were checked for. The donor area was covered with a medicated tulle gras dressing, and sterile dressing was done. Once the patient was shifted back to the ward, Ryle's tube was connected to a central suction between -85 and -125 mmHg, depending on the size of the wound. Intermittent suction was provided, and every 2 hours, a 15-minute break was given. On the fifth postoperative day, the dressing was removed, and graft uptake was evaluated. 48 participants were included in the prospective analytical study. A similar number of patients from each group—conventional or

NPWT—were randomly assigned to each group. Before assessing each patient, prior informed consent was sought. On a pre-tested proforma, information will be gathered on the patient's history, clinical examination, and investigations.

2.4. Mode of treatment

By features of radiological imaging, microbiology, and pathological intervention. Under spinal anaesthesia, each patient received surgery in accordance with their assigned group. Age, gender, ulcer site, and co-morbidity-related data were gathered. Based on the culture sensitivity results from the swab taken before surgery, antibiotic coverage was administered. Following up with all patients at 1, 3, and 6 months was done. The trial will run from November 2018 to October 2020.

2.5. Statistical Methods

The Statistical analysis was performed by STATA 11.2 (College Station, TX USA). The Shapiro-Wilk test was used to find normality. Student's Independent sample t-test was used to find the significance difference between the age and length of stay with groups (Conventional and Negative pressure), and it is expressed as the mean and standard deviation. The Chi square test for goodness of fit was used to measure the association between the age distribution, gender distribution, location of ulcer, graft uptake, complications, revision of surgery, and co-morbidities with groups (Conventional and Negative pressure), and it is expressed as frequency and percentage.

3. Results

Table 1 Comparison of mean age with the groups

Variable	Conventional	-Ve Pressure	P-Value
	Mean ± SD	Mean ± SD	
Age (In Years)	48.96 ± 11.64	47.67 ± 13.12	0.935

Table 2 Comparison of gender with groups

Gender	Conventional	-Ve Pressure	Total	P-Value
Male	18 (75%)	12 (50%)	30	0.031
Female	06 (25%)	12 (50%)	18	
Total	24	24	48	

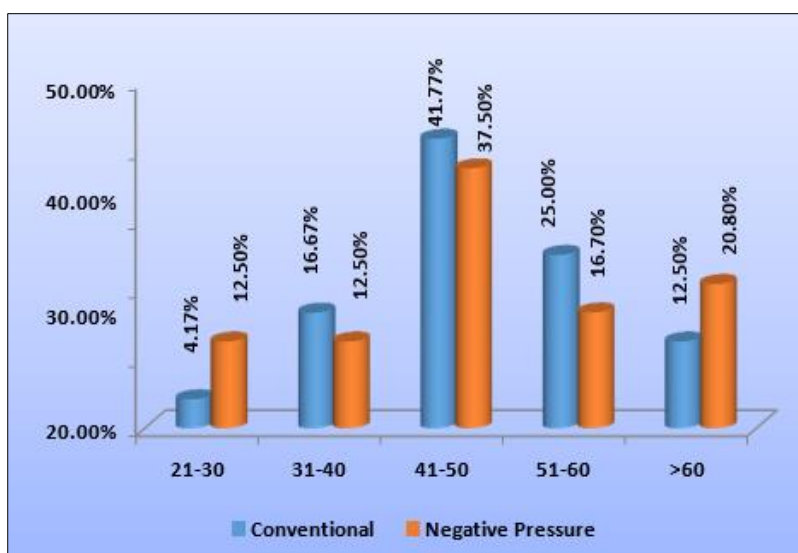
Table 3 Comparison of Location of ulcer with groups

Location of ulcer	Conventional	-Ve Pressure	Total	P-Value
Foot	09 (37.5%)	10 (41.7%)	19	0.949
Leg	10 (41.7%)	09 (37.5%)	19	
Thigh	05 (20.8%)	05 (20.8%)	10	
Total	24	24	48	

Table 4 Comparison of Graft uptake with groups

Groups	Conventional	-Ve Pressure	Total	P-Value
1	01 (4.17%)	00	01	<0.001
2	11 (45.83%)	00	11	
3	11 (45.83%)	1 (4.17%)	12	
4	1 (4.17%)	23 (95.83%)	24	
Total	24	24	48	

In the current investigation, the IQR of the patients in both groups was between 41 and 50 years. The negative pressure group had 9 patients (37.5%), whereas the conventional group had 10 patients (41.77%) in this age group. This wasn't statistically significant, though. In contrast, there was no statistically significant difference in the mean ages of the two groups. In our study, 6 (25%) of the 24 patients in the conventional group were female, compared to 18 (75%) of the 24 patients who were male. Twelve (50%) of the 24 patients in the negative pressure group were male, and twelve (50%) were female ($p = 0.001$). Most of the ulcers were located in the foot, leg, and thigh. In the Conventional group, 9 patients (37.5%) had an ulcer in the foot, 10 patients (41.7%) in the leg, and 5 patients (20.8%) in the thigh. In the negative pressure group, 10 patients (41.7%) had an ulcer in the foot, 9 patients (37.5%) in the leg, and 5 patients (20.8%) in the thigh ($p > 0.01$). Statistically, it was seen as insignificant. As per the findings, the patients were categorised into four groups based on the graft uptake in comparison to the overall size of the ulcer. Graft uptake of less than 50% was assigned under group 1; 50%–75% under group 2; 75%–85% under group 3; and 85%–100% under group 4.

**Figure 1** Comparison of Age distribution with groups

Most of the patients in the conventional group had a graft uptake between 50 and 85%, whereas a majority of the patients with negative pressure had a graft uptake of more than 85%. The comparison of graft uptake between groups showed statistical significance (chi-square 10.22, $p = 0.01$). The patients in the conventional group had a higher number of days of hospital stay when compared to the negative pressure group, with the mean hospital stay of the patients in the conventional group being 18.54 +/- 3.01 days, whereas the mean hospital stay of the patients in the negative pressure group was much lesser at 11.38 +/- 1.06 days. This was found to have statistical significance ($p = 0.01$). Another finding was found during the assessment: the conventional group had around 6 cases (25%) while no patients in the negative pressure group had any complications such as graft infection or graft rejection. This relied on the statistical significance between the two groups ($p < 0.01$). All six patients in the conventional group who had complications underwent revision surgery, accounting for 25% of the cases in the group. No cases in the negative pressure group required a second surgery. While most of the patients in both study groups had no co-morbidities, Only 2 patients

(8.33%) were anaemic; 6 patients (25%) were diabetic in the conventional group, while 1 patient (4%) was anaemic and 11 patients (46%) were diabetic in the negative pressure group.

4. Discussion

Skin serves many purposes. It serves as a barrier against pathogens and water loss and offers defence against a variety of trauma types, such as thermal, chemical, and UV radiation. Through a variety of nerve endings, the skin keeps us connected to our surroundings, controls body temperature, improves metabolic processes, and synthesizes vitamin D. ¹² Transferring cutaneous tissue from one area of the body to another is known as skin grafting, and it is frequently done to cover significant wounds. The goal of skin grafts is to transplant healthy skin from a donor site with a normal healing propensity to a recipient site. Following integration, skin grafts shield wounds from the elements, infections, heat, and excessive water loss like healthy skin. By definition, a split-thickness skin graft (STSG) is a graft that only includes the epidermis and a small section of the dermis, as opposed to a full-thickness skin graft (FTSG), which includes both the epidermis and the complete dermis. ¹³ Negative Pressure Wound Therapy (NPWT) is a more recent noninvasive adjunctive therapy system that uses controlled negative pressure with a Vacuum-Assisted Closure Device (VAC) to aid in the promotion of wound healing by draining fluid from open wounds through a sealed dressing and tubing that is connected to a collection container. It has been demonstrated that applying sub-atmospheric pressure dressings to various wounds is an efficient technique to speed up healing. The following findings were made in an effort to assess the effects of negative pressure wound care vs. traditional dressing in patients following skin transplantation. Most of the patients in both groups were between the ages of 41 and 50, followed by those between 51 and 60. In the traditional group, the mean age was $48.96 + 11.64$; in the negative pressure group, it was $47.67 + 13.12$. This is comparable to other studies that indicate patients in their middle or late years develop ulcers. In a study conducted in 2016 by Tesfamichael G. Mariam et al., the mean age with SD of the 279 patients who had leg ulcers was 49.8 years. ⁹² Another study by Leila Yazdanpanah et al. (2018) examined the incidence and risk factors of diabetic foot ulcers in a population-based diabetic foot cohort. Study): The fact that 30 of the 48 patients in our study were men and the other 18 were women indicates that more men than women are predisposed to developing ulcers. The prevalence of diabetic foot ulcers in men was higher than in women worldwide, according to a study by Zhang et al. (2016). In our study, 30 of the 48 patients were men, while the remaining 18 were women, demonstrating that more men are susceptible to developing ulcers than women. This is consistent with a study by (Zhang et al.2016) that was published in 2016 and found that males were more likely than females to develop diabetic foot ulcers globally ¹⁷ In our study, 17 of the 4 (201ns) , while only 3 were anaemic. (Joseph et al. 2002) studied lower extremity ulcers in 94 patients; six of these had diabetes, including 13 who were dialysis dependent; the remaining 28 patients had other chronic nondiabetic wounds, demonstrating that diabetic ulcers account for the majority of ulcer cases. We noticed in 2002 that patients in the negative pressure wound group had higher rates of graft uptake and almost no complications, such as graft infection, graft rejection, and subsequently graft loss, when compared to the conventional group of patients. Around 6 patients of the conventional group required revision surgery. According to research by Joseph et al. (2002), published in 2019, NPWT is more effective than standard dressing at fixing skin grafts because it provides consistent pressure and better drainage. In the study, 186 patients in total underwent skin grafting, with 72 receiving NPWT and 114 receiving traditional mechanical dressing. The overall survival rate of skin grafts was significantly higher in the NPWT group than the dressing group. In another study conducted by Yingchao Yin et al. (2018), a systematic review was done on 653 patients, and compared with conventional therapy; NPWT significantly increased the rate of graft take and reduced the rate of reoperation when applied to cover the wound bed with a split-thickness skin graft. Patients of the negative pressure wound the real. (2018), had a lesser hospital stay thus further patients, financial burden and infection rates post-op increased the conventional group. No difference in outcomes was observed compared to patients who were hospitalized for the full 5 days postoperatively.

5. Conclusion

In conclusion, demographic factors, such as ageing and a rise in diabetes and obesity, are probably the cause of the rising number of complex and chronic wounds that surgeons are seeing. Wound care has improved over the past 20 years thanks to the development of negative pressure wound therapy.

Acute and chronic wounds are treated using negative pressure wound therapy (NPWT), which is also referred to as vacuum assisted closure (VAC), subatmospheric pressure dressing (SPD), vacuum sealing technique (VST), foam suction dressing, sealed surface wound suction (SSS), vacuum pack therapy, and sealing aspirative therapy. In order to apply the treatment, a vacuum source must periodically or continuously generate negative pressure inside the wound.

By doing this, fluid and infectious exudates are removed, promoting wound healing and closure. Negative pressure wound therapy seems to be one of the most promising therapeutic techniques for ulcers and skin grafting, with more

recent improvements in wound care. It also reduces the number of dressing changes and subsequently decreases damage to delicate new tissue, pain, desiccation, and exposure to nosocomial infection. The benefits of negative pressure wound therapy, such as earlier discharge from the hospital, fewer wound dressing changes, economic feasibility, lesser dependence on nursing staff, and improved quality of life, make it a more superior and promising mode of treatment for patients with wounds, especially those who have undergone split thickness skin grafting procedures.

The commonest presentation of ulcers of any aetiology in our study is between 41-50 years old, with the mean age being around 48 years. Males are more commonly affected when compared to the female population. Over half of the patients in our study had no co-morbidities; but the most common comorbidity was diabetes, accounting for around 1/3 of the cases. Most of the ulcers were located on the foot and leg. Graft uptake was much higher in the negative pressure group owing to enhanced microcirculation and decreased infectivity rates when compared to the conventional group, which required frequent dressing changes and more nursing time. In the present study, patients with negative pressure wound therapy had a shorter hospital stay when compared to patients in the conventional category, thus making it more economically feasible and decreasing the overall financial burden on the patient. The negative pressure wound therapy group of patients had nearly no complications, thus diminishing the need for revision when compared to the conventional group, in which 1/4 of the patients required revision surgery. We summarized that negative pressure wound therapy is a potentially promising treatment option for managing wounds and improving the outcome of skin grafting procedures.

Limitations

Small sample size and short duration of the study. Loss of follow-up for some patients. By comparing ulcer size, ulcer etiology, location of the ulcer would be different for patients and will be affected the study outcome regarding the efficiency of newer methods of treatment.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of Interest between the funding agency and

Statement of ethical approval

Institutional ethical clearance was obtained as per the study protocol

Statement of informed consent

Informed consent was obtained from both local and English Language

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