Original Article

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Evaluation of Effect of Negative Pressure Wound Therapy on Split Thickness Skin Graft Take

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Abstract

Background: Conventional dressing of choice is a cotton bolster or sterile compressive dressing that is used for at least five days. The negative pressure wound therapy using reticulated open cell foam dressing conforms to the wound geometry by addition of negative pressure and promotes skin graft adherence while removing exudates and oedema from surrounding tissues.

Methodology: An observational comparative study was conducted in our department from November 2016 to may 2018. A total of 60 patients were included and the subjects were divided in 2 study groups Group-A i.e. standard dressing group and Group-B i.e. negative pressure wound therapy group of 30 patients each. Initially, during intra-operative period, size of the grafted area was measured in surface area using graph sheet method. Photographs were taken intra operatively and on post operative day 7, Percentage of graft take was measured on post operative day 7. Besides these some other variables were also compared.

Result: In Group B, the mean area of grafted wound was 396.70 cm^2 with standard deviation of 94.57 and the graft take on postoperative day 7 was 391.83 cm^2 with standard deviation of 93.23 showing the statistically significant difference when compared group A. None of the patients in Group B had shown any evidence of haematoma/seroma. Mean numbers of days of hospital stay were less in Group B.

Conclusion: Negative pressure wound therapy is effective in improving the percentage of split thickness graft take.

Keywords: Wound; Therapy; Negative pressure; Skin graft; Haematoma.

Abbrevation: NPWT – Negative pressure wound therapy; STSG – Split thickness skin graft; ROCF - Reticulated open cell foam; VAC – Vacuum assisted closure.

Introduction

STSGs currently represent the most rapid, effective method of reconstructing large skin defects. Graft survival is by following physiological events; i.e Plasmatic imbibition, inosculation and neovascularisation. The initial ‘take’ (or incorporation) occurs by diffusion of nutrition from the recipient site, termed ‘plasmatic imbibition’. Revascularisation generally occurs between days 3 and 5 by reconnection of blood vessels in the graft to recipient site vessels or by in growth of vessels from the recipient site into the graft [1]. The major causes of graft loss are hematomas and formation of blisters under the graft which interferes with graft survival [2,3]. The Successful STSGs take require immobilisation of the graft to prevent shearing, infection and seroma or haematoma formation beneath the graft. To achieve all of the above requirements, we need uniform pressure over the entire grafted area through a non adherent, semi-occlusive, absorbent dressing material. Conventional dressing of choice is a cotton bolster or sterile compressive dressing that is used for at least five days. The negative pressure wound therapy using reticulated open cell foam (NPWT/ROCF) [4] dressing conforms to the wound geometry by addition of negative pressure and promotes skin graft adherence while removing exudates and oedema from surrounding tissues. This study was conducted to evaluate the clinical outcomes of rate of STSGs uptake treated with NPWT and conventional dressing.

Methodology

An observational comparative study was conducted in our department from November 2016 to may 2018. A total of 60 patients were included and the subjects were divided in 2 study groups Group-A and Group-B of 30 patients each. Initially, during intra-operative period, size of the grafted area was measured in surface area using graph sheet method (Fig. 1).

Graph method to measure wound size

Impression of wound taken using transparent sheet and drawn over graph sheet. Area of one square is 1 sq cm. Complete square is counted as 1. Half squares counted as half squares and more than half squares counted as 3/4 and less than half squares as ¼

Total area (in cm^2) = No of Complete squares X 1+ no of half squares X ½ + no of more than half squares x ¾ + no of less than half square X 1/4

Example: Fig. 1: shows 306 full squares and 12 half squares

Total area = 306 X1 + 12 half squares X1/2

= 306+6

= 312 cm^2

The donor site and the site to be grafted was cleaned with Betadine solution and saline solution. The STSG was harvested, taking opposite thigh as a donor area. The STSG was meshed with a scalpel no.11 and was fixed to recipient site with sutures or skin staples. Once the graft was fixed, the patient was randomly assigned to standard dressing (Group-A) or negative pressure wound therapy (Group-B)

Group-A: Standard dressing is a cotton bolster dressing to ensure contact and immobilization between the split thickness skin graft and host bed.

Group-B: In NPWT group, the non adherent dressing is placed over STSG. The vac sponge was cut to match the contour of the wound and was secured to surrounding skin using adherent occlusive dressing. The VAC tubing was then connected to a pump that provides 125 mmhg continuous negative pressure. (Figs. 2 to 8)

Splinting was done for immobilization in extremity skin grafts. NPWT was continued till post operative day 7. On postoperative day 7, the percentage of graft take was assessed in both the groups. Photographs were taken intra operatively and on post operative day 7, Percentage of graft take was measured on post operative day 7.

Percentage of STSG take

$$= \frac{\text{Area with graft take}}{\text{Grafted area}} \times 100$$

Results

A total of 60 patients (n=60) were included in our study. In all the patients, wound cultures were sent prior to grafting. None of the wound cultures had shown any growth of organisms. The mean age of the study subjects in NPWT Group was 36.07 years and in Standard dressing Group was 39.27 years [Table 1]. Different variables were being analysed between the two groups using appropriate statistical methods namely Chi-square test, Student –T test and Fisher test. taking 0.05 as P -value just significant at 5 percent level when the mean of the sample lies just within 95 percent confidence limit.

Table 1: Demographics of the patients, aetiology and distribution of wounds

Variable	Standard dressing n=30	NPWT n=30
Age (in years) (Mean ± SD)	39.27 ± 9.35	36.07 ± 8.82
Sex		
Male	17 (57%)	20 (67%)
Female	13 (43%)	10 (33%)
Cause of wound		
Post infective	9	10
Post traumatic	16	15
Burn	5	5
Site of wound		
Upper limbs	1	1

Leg and thigh	5	11
Thigh	16	9
Leg	8	9

There was no statistically significant difference in the distribution of the ages in the two groups (p Value = 0.178).

Table 2: mean area of wound, mean graft take and loss and mean duration of hospital stay

Variable	Standard dressing Mean ± SD	NPWT Mean ± SD	p-value
Area of wound grafted (cm sq)	328.43 ± 87.56	396.70 ± 94.57	0.005
Graft take (cm sq)	274.9 ± 49.87	391.83 ± 93.23	<0.001
Duration of Hospital Stay (in days)	9.83 ± 3.72	7.0 ± 0	<0.001

In NPWT Group, there were 20 males and 10 females out of total 30 study subjects whereas in STANDARD dressing Group, there were 17 males and 13 females. However, the difference was not statistically significant (p Value = 0.426). The total number of patients with post infective raw area were 10 and 9 in NPWT and standard dressing group respectively. The total number of patients with post traumatic raw area were 15 and 16 in NPWT and standard dressing group respectively. The total number of patients with post burn raw area were 5 each in NPWT and standard dressing group respectively.

The anatomical area of raw area were thigh, leg and forearm.

In NPWT group, the mean area of grafted wound was 396.70 cm^2 with standard deviation of 94.57 and the graft take on postoperative day 7 was 391.83 cm^2 with standard deviation of 93.23. In standard dressing group, the mean area grafted wound was 328.43 cm^2 with standard deviation of 87.56 and the graft take on postoperative day 7 was observed to be 274.9 cm^2 with the standard deviation of 49.87. The difference was statistically significant with *p-value* <0.001. The mean percentage of graft take in the NPWT group was 98.37% with standard deviation of 0.85 and the mean percentage of graft take in standard dressing group was 84.23% with standard deviation of 9.14. The difference was statistically significant with p Value <0.001 [Table 2].

Decreased graft take was observed in patients of standard dressing group and haematoma/seroma were seen as the commonest cause for decreased graft take.

Haematoma/seroma were seen in 6 patients, out of total 30 patients in standard dressing group.

None of the patients in NPWT group had shown any evidence of haematoma/seroma. Mean numbers of days of hospital stay in NPWT Group were 7.0 days whereas in Standard Group those were 9.83 days. There was statistically significant difference in the total duration of hospital stay in the two groups (p Value <0.001).

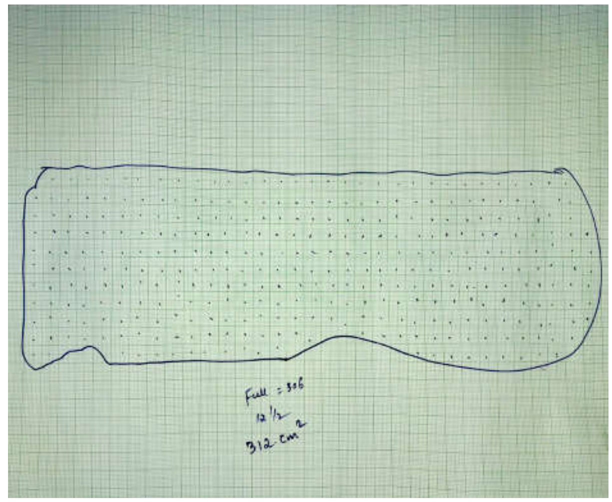

Fig. 1: Graph Sheet Method

Fig. 2: The Raw Area Resurfaced With Split Thickness Skin Graft

Fig. 3: The Npwt Dressing was Done Over The STSG

Fig. 4: Post Operative Day 7: Showing Almost 98% Graft Take

Fig. 5: Post Traumatic Raw Area Over Thigh And Leg

Fig. 6A:

Fig. 6: The Raw Area Resurfaced with Split Thickness Skin Graft

Fig. 7: The Raw Area Resurfaced with Split Thickness Skin Graft

Fig. 8: Post Operative Day 7: Showing Almost 97% Graft Take

Discussion

In our study, out of 60 patients, 37 were male patients and 23 were female patients. The predominant age group are between 31-40 years. NPWT has been used for the integration of STSG for wounds of varied aetiologies. Most of the wounds in both the groups of our study were caused by trauma, burns and infection.

Trauma was the leading cause of wounds in the series presented by Moisidis et al. [5] and Jeschke et al. [6] as seen in our study where out of total 60 patients with raw area, 15 patients in NPWT group and 16 patients in standard dressing group were caused due to trauma. While Llanos et al. [3] Scherer et al. [7] reported the use of NPWT over graft mostly in burns. NPWT has been used over STSG for the coverage of wounds ranging from small to large sizes. The mean wound sizes of the two groups of our study were 396.70 ± 94.57 cm2 in NPWT and 328.43 ± 87.56 cm^2 in Standard dressing groups, respectively. Scherer et al. [7] have reported similar mean wound size as our study. Nonstandard/custommade NPWT has been used over STSG by Llanos et al. [3] Petkar et al. [8] and Dorafshar et al. [9] with comparable results.

Assessment of postoperative graft take.

The mean percentage of graft take in the NPWT group was 98.37 with standard deviation of 0.85 and the mean percentage of graft take in standard dressing group was 84.23 with standard deviation of 9.14. the difference was statistically significant with p Value <0.001. Mir Mohsin et al. [2] assessed a post graft take in NPWT group was 99.74% ± 0.73% compared to 88.52% ± 9.47% in the non-NPWT group which is similar to our study. Several studies like scherer et al. [7], Llanos et al.[3], jeschke et al. [6]., moisidis et al. [5], have reported statistically significant difference in the quality and quantity of graft take using NPWT over graft as compared to conventional dressing, similar to our results [3,5,6,7]. In our study, None of the patients in the NPWT group and standard dressing group required second coverage procedure. Moisidis et al. [5]. Reported no need for regrafting any case in either of the two groups. Initial graft survival with NPWT reduces the need for regrafting, which may eliminate repeated surgical procedure, surgical expenses and hospital stay [10]. Many studies like scherer et al. [7], Llanos et al. [3], Blume et al. [10], have reported significant reduction in the reoperation rates in the grafts covered by NPWT as found in our study. In our study the skin graft take was assessed on post operative day 7 in both the groups and patients with standard dressing required a longer healing period as the graft take was relatively less when compared with NPWT group. All the patients with NPWT group were discharged on 7th day from the day of grafting. whereas in standard dressing group, 4 cases had to stay beyond 10 days.

The length of post STSG hospital stay was reduced in NPWT group. Mean numbers of days of hospital stay in NPWT Group were 7 days whereas in Standard dressing Group those were 9.83 days. With standard deviation (S.D) as 0.0 and 3.72 respectively. The difference in total hospital stay between the standard dressing group and NPWT group was found out to be statistically significant with p value <0.001 which was co-related with similar study done by Llanos et al. [3] Llanos et al. [3] who noted that the mean postgrafting hospital stay was 8 days (range 7–13 days) in the negative pressure group versus 12 days (7–23 days) in the control group which was statistically significant (p = 0.001) and is Similar with our study. On utilising NPWT, the use of uncomfortable splinting techniques to immobilise extremities has become unnecessary. Morykwas et al.found in their studies that 125 mmHg of subatmospheric pressure applied to the wound bed was the most efficacious concerning the blood flow. The same pressure level was also applied in consecutive studies described in their paper [11]. We used a subatmospheric pressure of –125 mmHg for all patients age included in our study. Negative pressure dressings improves graft survival. First, an important aspect to successful graft take is maintaining good apposition between the graft and the wound surface. By design, continuous negative pressure dressings provide an uniform distribution of negative pressure and apposition between the graft and the wound bed in most cases, even if the surface contour is irregular [12,13]. This becomes particularly important for patients with traumatic injuries necessitating skin grafting as these grafts are often in irregularly contoured regions such as the wrist, knee and ankle. Second, accumulation of hematoma or seroma under the graft contributes to graft loss. The negative pressure dressing provides continuous removal of wound fluid, which prevents the accumulation of hematoma or seroma while maintaining graft to wound apposition [12,14]. Third, desiccation is detrimental to wound healing [15] and is reduced with the occlusive nature of the NPWT dressing, in which a moist environment is maintained. Lastly, infection contributes to graft loss. NPWT has been associated with lower bacterial counts at wound sites 2, and this reduction in the local bacterial flora may enhance graft survival. In standard dressing group, the most common cause of graft loss was found out to be haematoma/seroma which was observed in 6 out of 30 patients and None of the patients in NPWT group, the complication like haematoma / seroma was not seen.

Conclusion

NPWT is a safe, useful and effective technique in integration of STSG. The NPWT increases the percentage of graft take when compared to standard dressing the NPWT, decreases the need for second stage grafting and reduces the duration of hospital stay. To conclude, negative pressure wound therapy is effective in improving the percentage of split thickness graft take.

Conflict of Interests: None

Funding Source: None

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Declaration: The study is inaccordance with the ethical standardsof the responsiblecommitteeon human experimentation (Institutional or Regional) and with theHelsinkideclaration of 1975, as revised in 2000.

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