A Comparative Study of Negative Pressure Dressing with and without Silver Alginate to Promote Faster Wound Healing in Chronic Wounds

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ABSTRACT

Objective: To determine the effectiveness of negative pressure dressing with silver alginate hydro-fibre dressings in managing chronic wounds compared to negative pressure dressing without silver alginate hydro-fibre dressings.

Study Design: Cross-sectional analytical study.

Place and Duration of the Study: Department of Plastic and Reconstructive Surgery at Dr Ruth K.M. Pfau Civil Hospital Karachi from Jan to Jul 2021.

Methodology: All patients above 18 years of age of either gender presented with more than six weeks of wound duration, hemoglobin levels more than 10 g/dl, platelet count above 150 x 10E9/L, and size of the wound more than 10*10cm were consecutively enrolled. Negative pressure dressings with and without hydro-fibre dressings were applied. A team of plastic surgeons monitored the wound site to assess granulation tissue by noting the size of the wound and pain severity. The outcome was assessed at four weeks.

Results: Of 62 patients, the median age was 43 (32.5-56.7) years. There were 37 (59.67%) males and 25 (40.32%) females. The outcome assessment at four weeks showed that overall pain was observed in 34 (54.83%) patients. Pain severity (p-value <0.001) and low granulation score (p-value 0.025) were found significantly higher in patients who received negative pressure dressing without silver alginate as compared to the patients who received negative pressure dressing with silver alginate. A significant median difference in granulation days was observed between groups (p-value <0.001).

Conclusion: Combining negative pressure dressings with silver alginate dressing has a positive effect on the chronic wound compared to using negative pressure dressings alone.

Keywords: Chronic wound, Negative pressure dressings, Silver alginate.

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INTRODUCTION

Chronic wounds are defined as wounds that persist even after 4-6 weeks.[1] Multiple factors like peripheral vascular diseases can cause chronic wound, prolonged pressure leads to the ulceration of a wound, and both angiopathy and neuropathy in diabetes lead to an increased risk of chronic wounds.[2,3]

The main goals of dressings include keeping the wound moist, reducing infection, and lessening wound exposure to the environment. A range of dressings are available in the market to accomplish these goals, but few of them are provided in our government-based free setup. Choosing an appropriate dressing that suits every wound is difficult as no comparison study has been conducted among them.[4-6]

Negative pressure wound dressings are new innervation in chronic wound therapy that reduces wound exudate, decreases wound size, increases vascular perfusion and promotes granulation tissue dressings like alginates, foams, hydrocolloids, and hydrogels help to keep wound moist.[4]

Silver has been proven a bactericidal agent in the scientific literature,[7-9] and is currently being used in dressings in various forms like ions, nanocrystalline silver, inorganic complexes and silver sulfadiazine.

Studies on the effect of negative pressure dressings on chronic wounds have shown promising results. Likewise, hydro-fibre dressings with silver alginate have a good literature review. However, there is an extreme scarcity of literature on whether the combination of these dressings is effective or not. Therefore, it is essential to study the effect of its combination in managing chronic wounds. This study aims to compare if negative pressure dressing with and without silver alginate can promote faster wound healing in chronic wounds.

METHODOLOGY

This cross-sectional analytical study was conducted at the Department of Plastic and Reconstructive

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Surgery at Dr Ruth K.M. Pfau Civil Hospital Karachi from Jan 2021 to July 2021. Before conducting the study, ethical approval was obtained from Dow University of Health Sciences (DUHS) (IRB-1628/DUHS/Approval/2020/). Moreover, signed informed consent was also obtained from all study participants before enrolment.

Inclusion Criteria: All the patients admitted for wound coverage with skin grafting were consecutively enrolled. The inclusion criteria were (i) above 18 years of age, (ii) either gender, (iii) wounds for more than six weeks duration, (iv) history of trauma, tumour, congenital physical abnormalities, (v) haemoglobin levels more than 10 g/dl, (vi) platelet count above 150 x 10E9 /L, and (vii) size of wound > 10*10cm.

Exclusion Criteria: Patients with the following characteristics were excluded: (i) pressure ulcers, (ii) bleeding vessels, (iii) presence of necrotic tissue, and (iv) malignancy in wounds.

All patients were enrolled via non-probability consecutive sampling. The sample size for the current study was calculated using OpenEpi.com online sample size calculator, employing the effect of SACMC on the formation of granulation tissue after four weeks compared to non-silver alginate dressing as 12% vs 47%, as reported by Beele *et al*,[10] the sample size was calculated to be 62 (31 in each group) at 95% confidence level and 80% power.

Patients were dressed inward with negative pressure dressings with and without hydro-fibre dressings. It was changed every 48 hours. Wounds were monitored through photographic assessment and clinical examination that included the size of the wound, colour of the wound, and oedema.

Data were collected with the change of dressings at the wound site. Study objectives were discussed and explained to the patients before applying negative pressure dressings. In addition, the potential benefits and discomforts of the procedure were explained. Participants received both oral and written information about the study. Finally, the participants filled out the consent form. The wound was covered with negative pressure dressings composed of a sterile foam dressing surrounded by an occlusive film that adheres to the nearby, normal skin. Suction was applied to the dressing, and a draining tube was connected to a wall fixed assisted vacuum canister. Patients were provided with paper chits with A or B marked on them. Patients picking up A chit were dealt with as A group where the proximal part was covered with vacuum-assisted closure (VAC) dressings, whereby patients picking up B chit were dealt with as B group where the proximal part was covered with a single layer of silver alginate hydrocolloid dressings. Such a dressing pattern was followed in every change of dressing in 48 hours. The wound site was photographed after every change of dressings. A team of plastic surgeons photographically monitored the wound site to assess granulation tissue by noting the size of the wound, colour and shine of granulation tissue and oedema. The outcome was assessed at four weeks.

Statistical Package for the social sciences (SPSS) version 24 was used for statistical analysis. Descriptive analyses were explored using the median and interquartile range for quantitative and frequency/percentages for qualitative variables. In addition, the Mann-Whitney U test and chi-square/Fisher-exact test were applied to explore the inferential statistics. The *p*-value of ≤0.05 was considered significant.

RESULTS

Of 62 patients, the median age of the patients was 43 (32.5-56.7) years. There were 37 (59.67%) males and 25 (40.32%) females. The median height, weight, and BMI of the patients were 1.70 (1.50-1.76) m, 70.5 (66.0-76.5) kg, and 23.0 (22.8-25.9) kg/m2 respectively. Wounds secondary to a road traffic accident wound over the leg and wound over the foot were the most frequent diagnosis, i.e., 18 (29.03%), 14 (22.58%), and 11 (17.74%), respectively. Group-wise comparison of baseline characteristics showed that except diabetes mellitus (*p*-value 0.034) and smoking status (*p*-value 0.015), other baseline variables such as age (*p*-value 0.767), BMI (*p*-value 0.290), gender (*p*-value 0.796), diagnosis (*p*-value 0.106), and overweight/obese (*p*-value 0.246) had no significant difference in between groups (Table-I).

The outcome assessment at four weeks showed that overall pain was observed in 34 (54.83%) patients. Of these 34 patients, mild severity of pain was observed in 12 (35.29%) patients, moderate severity of pain in 18 (52.94%), and severe pain in 4 (11.76%) patients. Granulation score showed that 25-74% scoring was observed in 18 (29.03%) while >75% granulation score was observed in 44 (70.96%) patients.

The pain was found to be significantly higher in patients who received negative pressure dressing without silver alginate as compared to the patients who received negative pressure dressing with silver alginate, i.e., 26 (76.5%) and 8 (23.5%) respectively (*p*-value <0.001). Similarly, low granulation score (24-

75%) was significantly higher in patients who received negative pressure dressing without silver alginate as compared to the patients who received negative pressure dressing with silver alginate, i.e., 13 (72.2%) and 5 (27.8%) respectively (*p*-value 0.025) (Table-II).

Table-I: Comparison of baseline characteristics with respect to group (n=62).

	Group, n (%)		*p*-value
	A (n=31)	B (n=31)	
Age, years	43 (30-65)	43 (34-53)	0.767
≤40	15 (51.7)	14 (48.3)	0.799
>40	16 (48.5)	17 (51.5)	
Weight, kg	66 (56-76)	71 (70-78)	0.102
Height, m	1.63 (1.53-1.75)	1.70 (1.50-1.80)	0.448
BMI, kg/m^2	23 (23-25.9)	23 (22.8-25.9)	0.290
Gender			
Male	18 (48.6)	19 (51.4)	0.796
Female	13 (52.0)	12 (48.0)	
Diagnosis			
Wound over heel	6 (66.7)	3 (33.3)	0.106
Wound over foot	5 (45.5)	6 (54.5)	
Wound over leg	4 (28.6)	10 (71.4)	
Wound over ankle	3 (60.0)	2 (40.0)	
Wound sec to RTA	8 (44.4)	10 (55.6)	
Wound over forearm	5 (100)	-	
Diabetes Mellitus			
Yes	7 (31.8)	15 (68.2)	0.034
No	24 (60.0)	16 (40.0)	
Overweight/ Obese			
Yes	25 (54.3)	21 (45.7)	0.246
No	6 (37.5)	10 (62.5)	
Smoking status			
Yes	11 (78.6)	3 (21.4)	0.015
No	20 (41.7)	28 (58.3)	

BMI: Body Mass Index, Kg: Kilogram, m: meter, RTA: Road traffic accident, Group A: Simple VAC Dressing, Group B: VAC with silver dressing

Table-II: Outcome at 4 weeks with respect to group (n=62).

	Groups n (%)		*p*-value
	A (n=31)	B (n=31)	
Pain (n=62)			
Yes	26 (76.5)	8 (23.5)	<0.001
No	5 (17.9)	23 (82.1)	
Pain Severity (n=34)			
Mild	7 (58.3)	5 (41.7)	0.143
Moderate	15 (83.3)	3 (16.7)	
Severe	4 (100)	-	
Granulation Score			
25-74%	13 (72.2)	5 (27.8)	0.025
>75%	18 (40.9)	26 (59.1)	

Group A: Simple VAC Dressing, Group B: VAC with silver dressing

Of 44 patients with >75% granulation, the overall median day of granulation score achieved was 18.5 (16-21). A significant median difference in granulation days was observed between groups (*p*-value <0.001) (Table-III).

Table-III: Median difference of granulation day with respect to group.

Parameter	Study Groups		*p*-value
	Simple VAC Dressing (n=18)	VAC with Silver Dressing (n=26)	
Granulation Day	21 (20-25)	17 (15-18)	<0.001

DISCUSSION

The findings of the current study reported that a low granulation score was significantly higher in patients who received negative pressure dressing without silver alginate as compared to the patients who received negative pressure dressing with silver alginate. Furthermore, a significant median difference in granulation days was observed between groups. Beele *et al,*[10] and Opasanon *et al,*[11] also supported silver alginate in patients with chronic wounds.

According to the current study findings, the pain was considerably higher in patients who received negative pressure dressing without silver alginate than in patients who received negative pressure dressing with silver alginate. Meekul *et al,*[12] also reported a significant reduction in pain in patients who used silver alginate negative pressure dressing. Ozaki *et al,* also recommended silver alginate and reported no complications in lower extremity vascular surgery patients.[13]

A randomized, controlled study included 36 patients and divided them into two groups. One group was dressed with an ionic silver alginate dressing, and the other group with a non-silver calcium alginate fibre dressing, on chronic venous leg and pressure ulcers. The efficacy of the wound was evaluated over four weeks. The silver alginate dressing displayed better results than the silver alginate control dressing to control infections in wounds.[10] Numerous randomized controlled trials compared negative-pressure therapy to standard care for chronic wounds and assessed wound size and healing time. In ten trials, the author concluded that in the negative-pressure therapy group, both the wound size and healing time were decreased compared to the standard wound care group.[14] However, a recently published systematic review by Khansa *et al,*[15] has reported that silver is beneficial for the first few weeks in infected wounds, after which non-silver dressings should be used instead. The author further reported that silver confers no benefit for clean wounds and closed surgical incisions.

In their review paper, Percival and McCarty reported that antimicrobials, in particular silver, are incorporated into wound dressings, including alginates, for use in the treatment of at-risk or infected chronic wounds.[16] Moreover, they further stated that silver is used to reduce the dressing and wound microbial bioburden. Studies show that the antibac-terial potency of silver dressings against pathogens showed a decrease in bacterial counts over time.[17-21] However, in this study, antimicrobial patterns were not studied, which is one of the significant limitations of the current study.

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LIMITATIONS OF STUDY

There were some other limitations in this study as well. For instance, in the current study, randomization was not performed. All patients who met the inclusion criteria were consecutively enrolled. Secondly, other important variables like dietary practice, physical activity during the treatment period, arthritis history, and post-procedure complications like oedema are not reported. Finally, as the study was performed during the CornovaVirus-19 outbreak, collecting information from patients was difficult. Despite these limitations, this study was a significant effort in reporting the national findings on the important issue. Further studies are recommended on the same topic that covers all the deficiencies of the current study, as mentioned in the limitations.

CONCLUSION

In our study, a combination of negative pressure dressings with silver alginate dressing showed a positive effect on the chronic wound compared to using negative pres-sure dressings alone. It is highly suggestive to use silver alginate in chronic wounds due to its fast-acting performance.

Conflict of Interest: None.

Authors' Contribution

MA: Conceived idea, manuscript writing, accountable for the accuracy, integrity of study,HA: Proof reading, statistical analysis, FA: Literature searching manuscript writing, FA: Manuscript writing, data collection and analysis, AN: Data collection, critical review, UA: References writing, critical review.

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