Clinical Efficacy of Vaccum Assisted closure (VAC) in Wound Healing

Dr.Aruna nayaka. N, Dr.Akash M.V, Dr.Ravikiran K.M, Dr.Poojith

Assistant professor,Department of general surgery, JSS AHER,mysore
Assistant professor,Department of general surgery,JSS AHER, Mysore
Senior resident ,Department of general surgery Srinivas institute of medical science and research centre,Surathkal, Mangalore
Junior resident,Department of general surgery,JSS AHER,Mysore
Corresponding author-Dr.Poojith

ABSTRACT

Background and objectives – Diabetic and chronic wounds are a burden to the health care system. They need a lot of resources and manpower in the process of treatment. Our study aims to compare the VAC dressings with conventional dressings in wound healing, in terms of appearance of granulation tissue, wound contracture and hospital stay.

Methods – Hospital based prospective, comparative study was conducted on 65 patients admitted in the Department of General Surgery in JSS Medical College, Mysore between October 2020 to March 2022. Patients underwent a detailed History taking and Physical Examination after taking informed consent. Lab tests including CBC, RFT, SE, HBA1C, FBS, PPBS, BT, CT, HIV, HCV, HBsAg, culture and sensitivity, biopsy if needed, Arterial Doppler and radiological investigations. Patients were alternatively allotted to VAC dressings and conventional dressings.

Results – Our study found that there was a statistically significant association of appearance of granulation more rapidly, rapid wound contracture and lesser number of days of hospital stay in VAC dressings compared to conventional dressings.

Interpretation and Conclusion – VAC dressing is superior over conventional dressing in wound healing. It reduces hospital stay, reduction in antibiotic usage and early grafting of raw area.

Keywords: 'VAC dressings', 'Conventional dressings', 'granulation tissue', 'wound contracture','grafting'

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INTRODUCTION

Wound healing itself is an oldest topic of discussion in medical literature. Although there have been numerous advances in understanding the process of wound healing, management of chronic wounds and diabetic wounds remains a tough challenge. To solve this lots of modalities of dressings and local applicants have been developed and a lot of studies are still going on. Regardless of etiology, wounds are difficult to treat if coexisting

factors such as infection or diabetes mellitus prevent regular wound healing. Wounds represent a significant risk factor for hospitalization, psychological burden, amputation, sepsis and even death, and from the patient's perspective, wound therapy is often uncomfortable or painful.[1]

Chronic wounds result in significant functional impairment, reduction in quality of life, and large financial costs for patients and the health care system. Chronic wounds are a frequent problem in developing countries and affect atleast 1% of the population[1] and pose a heavy burden on both the patient and the service provider. Diabetes mellitus is the commonest cause in developing countries. The lifetime risk of developing limb ulcers mainly in the foot, among diabetics has been estimated to be 15%[2.]

While wound dressings have been used for centuries, there is no ideal dressing available. The choice of surgical dressing for both open and closed wounds is mainly based on tradition, training, and the surgeon's personal philosophy. Modern wound-healing concepts involve different types of moist dressings and topical agents, although only a few of these treatments have proven to be significantly more effective in promoting wound closure compared to traditional wet gauze dressings. Over the past two decades, various innovative dressings have been introduced. Negative pressure wound dressing, also known as vacuum-assisted closure, is a new technology that has shown promise in accelerating the growth of granulation tissue and promoting faster healing, thus reducing the time between debridement and definitive surgical closure in large wounds.[3]

In developing countries like India, where the cost of dressing is a major concern, locally constructed negative pressure dressings are an option.

Topical negative pressure using Vacuum Assisted Closure, also referred to as vacuum therapy, vacuum sealing or topical negative pressure therapy, is an advanced method for removing blood and serous fluid from a wound compared to conventional dressings that use saline gauze. It provides a new approach to wound dressing and is a technique for wound management that exposes the wound bed to controlled negative pressure through a closed system. It creates an optimal environment necessary for wound healing[4].

Hence, this study intends to establish the efficacy of VAC in comparison with conventional dressings in wound healing.

MATERIALS and METHODOLOGY

It was a Prospective, Comparative study; Patients from JSS Medical College, Mysore were selected between October 2020 to March 2022. 65 Patients with 33 VAC Dressings and 32 Conventional Dressing was considered as the required sample size. As per study conducted by Atef Bayoumi[4] et al comparable to present study where granulation tissue appearance in VAC group was 76% compared to control group was 28%, the sample size was calculated using below formula

$$n \geq \frac{K\,[\pi_1(1-\pi_1) + \pi_2(1-\pi_2)]}{\Delta^2}$$

Where n= number of individuals required in each group, π_1 and π_2 are proportions in the 2 group, = π_1- π_2 and K(14.83) is determined by power and significance level of the study. By the above formula n≥ 25 was obtained and sample size of 30 in each groups were considered in the study.

Inclusion Criteria

Age 18 years and above with diabetic and all other types of Chronic ulcers.

- Ulcer of minimum size 4X4cm

Exclusion criteria:

- Fistulas of organ or body cavities
- Osteomyelitis
- Malignant ulcer
- Ischemic ulcers
- Patient with bleeding disorders

Methodology

After obtaining clearance from ethical committee, patients fulfilling inclusion criteria will be allocated to VAC and conventional dressings, considering their diabetic and chronic conditions alternatively; after explaining the options of treatment and taking their written informed consent. The selected patients will be subjected to a detailed history elicitation including evaluation of risk factors, followed by clinical examination. They will then be subjected to

- Baseline investigations like- HB%, TC, DC, ESR, BT, CT, HIV, HBsAg, blood grouping, HbA1C, RBS, FBS, PPBS, Blood urea, Serum creatinine and Urine routine-microscopy.
- This will be followed by specific investigations like - Culture and Sensitivity, Biopsy if needed, and Doppler scan.

All patients underwent detailed clinical examination and relevant investigations and the wounds were thoroughly debrided and the ulcer dimensions as well as the surface area assessed. Before the start of VAC therapy, after initial debridement, the wound was photographed.

Before surgical intervention at the end of VAC therapy, the final appearance of the wound was again noted and recorded. The patients were followed up on a daily basis in both test and control groups. The control group was subjected to dressings by conventional methods whereas the test group was subjected to topical negative pressure dressings and was left undisturbed for 3 days.

Materials used

The application of topical negative pressure moist dressings needs the following materials.

They include:

- Synthetic hydrocolloid sheet
- Vacuum suction apparatus
- Transparent semi permeable adhesive membrane sheet.

Method of application

The VAC dressing is a combination of composite synthetic hydrocolloid sheet dressing with vacuum assisted wound closure systems. The technique involves following steps. All the patients included in Group II were subjected to these steps.

These were as follows:

1. The wound was thoroughly debrided and devitalized tissue removed. A perforated drain tube was placed on top of the wound bed and other end was brought out a little away from main wound
2. The hydrocolloid foam dressing soaked in povidone iodine solution was cut to size of the wound and applied over the drain tube.
3. The foam with the surrounding normal skin was covered with adhesive, semi permeable, transparent membrane. A good air seal was thus ensured around the wound.
4. Distal end of the drain tube was now connected to a device, which provided a negative pressure of -125 mmHg was applied to the wound, either continuously or intermittently (5 minutes ―on‖, 2 minutes ―off‖).
5. This was achieved by wall suction apparatus, computerized devices or mobile suction drain devices. Suction was applied continuously or intermittently based on the amount of wound discharge.
6. Once vacuum is applied, the foam must be seen collapsed into the wound bed, thus giving the surface a concave appearance.
7. The fluid from the wound is absorbed by the foam and is removed from the wound bed by suction.

Conventional dressing done after debridement and using hydrogen peroxide, betadine solution followed by saline wash and applying moist gauze and cotton pad. Repeated dressings changed every 1 or 2 days defending upon soakage.

The negative pressure was maintained for an average of 3 days for Maximum benefit as studies have proved. Once adequate granulation tissue was formed the dressing was removed and definitive wound closure achieved by skin grafting. At the end of three days

the wounds in both the groups were inspected after removal of the dressings from the test group.

The wounds were compared based on the following parameters. They are, - Rate of granulation tissue formation as percentage of the ulcer surface area - Wound contracture in millimetres.

Statistical analysis

Data will be analyzed by descriptive statistics, Student t test for comparison of two groups and Chi- Square for association. SPSS Version 17 will be used for data analysis.

RESULTS

Table1 and 2- Age wise distribution and association

Table no. 1 Distribution of methods of dressing

TYPE OF DRESSING	FREQUENCY	PERCENT
CONVENTIONAL	32	49.2
VAC	33	50.8
TOTAL	65	100

Table No. 2 Age distributions in both methods of dressings

	Age					Total	P value
	<=30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs		
Conventional	0	5	10	13	4	32	0.112
	.0%	15.6%	31.3%	40.6%	12.5%	100.0%	
VAC	2	1	8	12	10	33	
	6.1%	3.0%	24.2%	36.4%	30.3%	100.0%	
Total	2	6	18	25	14	65	
	3.1%	9.2%	27.7%	38.5%	21.5%	100.0%	

As per table 1 and 2 there is no statistically significant difference in distribution of age groups or gender in both the groups.

Table 3- Gender wise distribution

Table No 3: Gender distribution in both methods of dressings

	Gender		Total	χ^2 value	P value
	Male	Female			
Conventional	24	8	32	1.790	0.181
	75.0%	25.0%	100.0%		
VAC	29	4	33		
	87.9%	12.1%	100.0%		
Total	53	12	65		
	81.5%	18.5%	100.0%		

Table 4- Type of wound as per dressings

Table 5- Appearance of granulation tissue

Table No 4 Type of wound in both methods of dressings

	Type Of Wound		Total	χ^2 value	P value
	Diabetic	Chronic			
Conventional	29	3	32	0.128	0.721
	90.6%	9.4%	100.0%		
VAC	29	4	33		
	87.9%	12.1%	100.0%		
Total	58	7	65		
	89.2%	10.8%	100.0%		

Table No 5 Appearance of granulation tissue as percentage of ulcer bed in both methods of dressings

	N	Mean	SD	Min.	Max.	p value
Conventional	32	55.2	6.411	40	65	<0.001
VAC	33	83.3	9.326	65	95	

As per table 4 and 5 average of 55.2% of granulation tissue appeared in conventional dressings as compared to vac dressings in which an average of 83.3% of granulation tissue appeared at the end of 6th day of dressings. There is a statistically significant difference noted in appearance of granulation tissue in both methods of dressing.

Table 6- Wound contracture

Table no 6 Wound contractures in millimetre^2 in both methods of dressings

	N	Mean	SD	Min.	Max.	p value
Conventional	32	46.03	15.073	20	90	<0.001
VAC	33	97.64	38.703	40	192	

As per table 6 significant associations was seen in wound contracture in both dressings.

Table 7- Duration of Hospital Stay

Table no.7 Duration of hospital stay

	N	Mean	SD	Min.	Max.	p value
Conventional	32	16.00	1.481	14	19	<0.001
VAC	33	8.76	2.136	6	14	

As per table 7 mean duration of hospital stay was 16 days in conventional dressings as compared to 8.76 days in vac dressings. There is a statistically significant difference in duration of hospital stay
in both methods of dressings.

DISCUSSION

In this study it is demonstrated that the use of vacuum therapy in wounds results in improved wound healing compared to conventional moist gauze therapy. This is reflected by on average healthier wound conditions i.e. faster healing, rapid appearance of granulation and decreased hospital stay. One of the important advantages of vacuum therapy is the fact that healthier wound conditions were achieved without intermediate debridement. In most of the conventionally treated patients, debridement was necessary to remove slough. Correction of anemia done using hematinics and blood transfusion whenever necessary. Appropriate antibiotics used after empirical therapy after considering culture and sensitivity.[5] Diffuse atherosclerosis noted in 49 patients. Glycaemic control achieved using regular insulin if needed along acting insulin (basalog) also added

In our study granulation tissue appeared at the end of the six days of therapy 83.3% in VAC therapy and in conventional therapy it was 55.2%. Our study is comparable in appearance of granulation tissue in Dr. Pritham et al[1] in which was 78.6% in VAC therapy vs 51.92% in conventional therapy. Also comparable to Singh et al[4] in which granulation tissue appearance was 81.5% in VAC therapy vs 54.3%in conventional dressings. Our study is comparable with Atef Bayoumi et al[3] in terms of wound contracture at end of one week of VAC dressings. Average size of wound in our study was 94.58 cm^2 and 106.5 cm^2 VAC and conventional groups respectively. Contracture of wound for VAC dressings was 10.3% and 4.3% in conventional dressings in our study, compared to Atef Bayoumi et al in with wound contracture was 10.76% and 2.05% with the initial size of wound.[3]

Wound healing is a complex interdependent and intricate process involving many cellular interactions, release of biochemical mediators, changes in the microenvironment and extracellular matrix resulting in structural and functional

restoration of the wound.[6] Locally acting growth factors influence healing in the events of angiogenesis, formation of extracellular matrix, migration of neutrophils, macrophages, fibroblasts, increasing collagen and protein production thereby enhancing the healing of wound.[7,8] Any disturbance in this mechanism will delay in healing and lead to chronic non healing wounds. Application of sub atmospheric pressure decreases the bacterial colonization over the wound and increases the blood flow.[9] Increase in oxygenated blood flow to the damaged tissues increases the wound resistance to the infection.[10] Increased oxygenated blood flow to the wound healing promotes the oxidative bursts in neutrophils and there by promoting the killing of microbes and preventing infection.[11]

Hospital stay in our study was average of 8.76 days for VAC dressings and for conventional dressings it was 16 days, skin grafting was done. There is significant reduction in hospital stay in VAC dressings compared to conventional dressing owing to decreased antibiotic use, need for lesser number of dressings and good quality wound for skin grafting.

Stinner et al.[12] study in the goat model with silver dressings placed beneath the foam in complex wounds with high bacterial load demonstrated reduction in bacterial growth particularly S. aureus when compared to standard VAC dressings. Instillation therapy adding of fluid to the wound through a tubing in form of normal saline or other antimicrobials like sodium hypochlorite solution, dilute betadine, doxycycline, phenytoin, lactoferrin are done but trials are needed to prove it efficacy.

CONCLUSION

In our study of 65 cases 33 cases were subjected to VAC dressings and 32 cases were subjected to conventional dressings to compare the effectiveness of VAC dressings over conventional dressings in terms of appearance of red granulation tissue as percentage of ulcer surface area, rate of reduction of surface area of ulcer and duration of hospital stay. VAC plays an important role in closing wounds quickly, controlling infection, promoting angiogenesis, increasing blood flow, and promoting granulation tissue growth of wounds. It is now widely applied in all kinds of acute, chronic, and special wounds in clinic with good therapeutic results. In our study we found that VAC dressing was superior to conventional dressing.

As majority of our patients were diabetic, VAC dressings facilitated early wound healing and decreased the morbidity in our patient.

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