Journal of Kathmandu Medical College, Vol. 11, No. 1, Issue 39, Jan.-Mar., 2022

Low-cost vacuum-assisted closure dressing in wound management: An effective alternative for Nepal

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Abstract

Background: Low-cost vacuum-assisted closure (VAC) can be used as an alternative method for wound management.
Objectives: To observe the effectiveness of low-cost vacuum-assisted closure dressing in wound management.
Methods: A descriptive cross-sectional hospital-based study was conducted in the Department of Plastic Surgery, Kathmandu Medical College from April 2021 to February 2022 to observe age, sex, indication, type of wound with history of comorbidities, number of dressings, duration of hospital stays, and complications like: bleeding, haematoma, and delay in wound healing .
Results: A total of 22 patients were included by convenience sampling technique in the study with 21 (95.5%) acute and one (4.5%) case of chronic wound with ulcer. The mean age was 39 ± 18.157 years ranging from 13-76 years. Most of them were males (15, 68.2%). The mean duration of wound presentation was 5.45 ± 9.127 days ranging from 1-45 days. The mean duration of hospitalisation was 20.45 ± 11.467 days ranging from 5-45 days. Eight (36.4%) patients were with comorbidities like Diabetes Mellitus, Hypertension, Peripheral vascular diseases etc., and no mortality was recorded.
Conclusion: Low-cost Vacuum-assisted closure is a very easy and efficient alternative method for wound care.

Key words: Low-cost; Vacuum-assisted closure; Wound dressing.

INTRODUCTION

Delayed wound healing, mostly in complex wounds with comorbidities, is a major concern in wound management. It takes prolonged morbidity and requires major other reconstructive surgery which leads to increased total cost of the treatment. Vacuum-assisted closure (VAC) can be used as an alternative to the traditional methods of wound management which optimises the wound for spontaneous healing or by lesser reconstructive options. The VAC was first approved by Argenta and Morykwas in 1997.[1,2] The application of VAC reduces oedema, infection, increases local blood circulation, and subsequently promotes wound healing.[3] New methods for wound healing are being introduced day by day. Most of them are not useful regarding cost and efficacy. The aim of this study was to get the benefit of VAC in the management of acute and chronic wounds with limited resources and low-cost.

Access this article online

Website: www.jkmc.com.np

DOI: https://doi.org/10.3126/jkmc.v11i1.45488

HOW TO CITE
Bajracharya A. Low-cost vacuum-assisted closure dressing in wound management: An effective alternative for Nepal. J Kathmandu Med Coll. 2022;11(1):14-9.

Submitted: Jan 11, 2022
Accepted: May 3, 2022
Published: May 24, 2022

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ISSN: 2019-1785 (Print), 2091-1793 (Online)

METHODOLOGY

This descriptive cross-sectional study was carried out in the Department of Plastic Surgery, Kathmandu Medical College (KMC) Teaching Hospital, Sinamangal from April 2021 to February 2022. Institutional ethical committee of KMC (Ref. 2603202103) approval and patients' informed consent was taken before conducting the study. The sample size was calculate using Cochrane formula $n = z^2 pq/e^2$; where n = sample size, z score at 95% confidence interval = 1.96; p = 3.6%.[4] The prevalence of chronic wounds increases with age with a prevalence of 1.3%

in the German adult population, rising to 3.6% for those aged 65 years and over;[4] and the margin of error (e) taken at 8%. The total number of patients included by convenience sampling technique in the study was 22. Current study included patients with diabetic foot ulcers, bed sores, post traumatic wound, burns; crush injuries, necrotising fasciitis, fasciotomy wounds, Fournier's gangrene, complex perianal or ischiorectal wound, non-healing ulcers, etc. Exclusion criteria included patients with malignant wound, untreated osteomyelitis, and those with exposed arteries/nerves/anastomotic site/ organs and patients with immune-compromised. Frequency analysis was done using IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y., USA)

Method of VAC application: Wound is thoroughly debrided, irrigated with normal saline, adequate haemostasis is maintained. Sterile foams from Central Sterilisation Supply Department (CSSD) are used for dressing, white or pink (Polyvinyl alcohol, dense, hydrophilic with a pore size of 250 mm) used for surface wounds. A Romovac suction usually two drains of 14F tube is fixed in the foam with 2-3 cm apart and base of drains are fixed to skin with 3.0 silk, (the drain tube and skin suture changed every time of VAC dressing) which is connected to a vacuum pump. The wound is then sealed with an adhesive drape (Opsite). Drapes should cover the foam and tubing and at least 2 cm of surrounding healthy tissue to ensure a watertight/airtight seal and vaseline gauge at drain site to prevent indentation of tube. Continuous negative pressure of 125 -150 mmHg applied with hospital base wall mounted suction device (Figure 1). To assure the watertight/airtight Evercrepe normal cotton bandage was applied to the surrounding visible form margins of wound. The dressing is usually changed on third day. The cost analysis of this unit material above mentioned costs only Rupees 2000 Nepali currency which is equivalent to about 17 US dollars.

RESULTS

A total of 22 patients were included in the study with 21 (95.5%) acute and one (4.5%) case of chronic wound with ulcer. The mean age was 39 ± 18.157 years ranging from 13-76 years. Most of them were males 15 (68.2%). In acute wounds nine (40.9%) patients had post traumatic raw area, six (27.3%) patients had necrotising fasciitis of limbs, and three (13.6%) patients had Fournier's gangrene, two (9.1%) patients with post burn raw area and one (4.5%) with ischiorectal abscess with colostomy and one (4.5%) with chronic non-healing ulcer with peripheral vascular disease. The mean duration of wound presentation was 5.45 ± 9.127 days ranging from 1-45 days. The mean duration of hospitalisation from admission to date of discharge was 20.45 ± 11.467 days ranging from 5-45 days. Eight (36.4%) patients were with comorbidities like Diabetes Mellitus, Hypertension, Peripheral vascular diseases etc., and no mortality was recorded. Eleven (50%) patients had two sessions of VAC procedure (Table 1). In most of the cases wound healed by skin grafting, one (4.5%) case healed with secondary closure, and two (9.1%) healed by its own (Table 1).

CASE 1

A 30 years old man admitted to surgical ward with two days history of rapidly painful swelling with redness of scrotal and perianal skin. Later it was torn with blisters and blackish discoloration, which was initially debrided by general surgeon and managed with broad spectrum intravenous antibiotics. Serial three debridement was done by general surgeon; sepsis was controlled and handed over to plastic surgery department. The wound was covered with necrotic slough with purulent discharge with clots. Serial two more extensive debridement was done and VAC dressing was applied two times with the interval of three days between them and finally wound was healed by secondary intention (Figure 2: A-F).

CASE 2

A 68 years old male obese patient (body weight of 120 kg) with features of necrotising fasciitis of left sided anterior chest wall with history of uncontrolled diabetes mellitus. Initially patient was in intensive care unit and managed by surgical team, debridement was done two times. Later serial debridement and VAC application was done by plastic surgery team. Post VAC dressing, the patient was managed with split-thickness skin graft (STSG) to cover the defect in the anterior chest wall. On first post-operative day after STSG the drain tube was blocked with clots and bleeding was noted and managed with immediate bi-polar cauterisation to control bleeding, two pints of blood transfusion was done to maintain his haemoglobin of 8 gm/dl and was discharged with control blood sugar with insulin therapy (Figure 3: A-I).

CASE 3

A 35 years female presented with history of painful swelling and discoloration of right dorsum of foot for four days, diagnosed as Necrotising Fasciitis with known case of Systemic Lupus Erythematosus (SLE) diseases on medication with prednisolone therapy. Initial debridement was done and three episodes of VAC dressings applied and finally covered with STSG.

Table 1: Demographic and VAC data of the patients, N = 22

Age in years	**Mean ± SD**	**39 ± 18.157**
	Range	13 – 76
Sex, n (%)	Male	15 (68.2)
	Female	7 (31.8)
Number of VAC, n (%)	1	4 (18.2)
	2	11 (50)
	3	7 (31.8)
Post VAC procedure, n (%)	Secondary closure	1 (4.5)
	Healed on its own (secondary intention)	2 (9.1)
	Split-thickness skin graft (STSG)	19 (86.4)

Figure 1: VAC dressing needed materials (Foam, suction drains, Opsite and wall mounted suction)

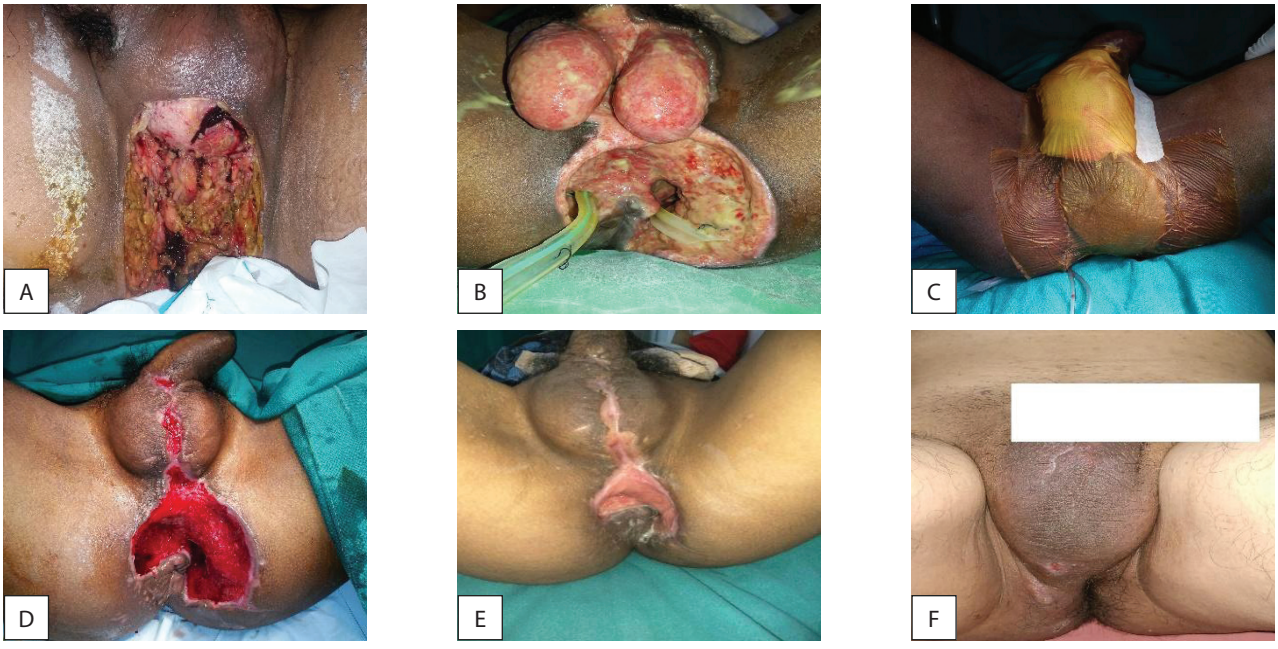

Figure 2: A: After third debridement; B: After fifth debridement; C: During VAC dressing; D: After two sessions of VAC dressings; E: During healing by secondary intention; F: After complete healing of wound

Figure 3 A: After second debridement; B: DuringVAC dressing; C: After debridement plus VAC dressings; D: Drain tube blocked with clots; E: STSG with clots; F: Post STSG seventh post-operative day; G: Around 80% graft uptake; H: At the time of discharge; I: Three months follow-up period

Figure 4 A: At the time of presentation; B: After debridement; C: During VAC dressings; D: Post VAC dressing; E: Uptake of graft STSG on seventh post-operative day; F: Follow-up after one month

DISCUSSION

The mechanism of vacuum-assisted closure is clear, it reduces bacterial load, accelerates wound healing by stimulating process of angioneogenesis which subsequently increases blood flow; and improved wound bed preparation for skin coverage.[5,6] The compression of tissue by negative pressure causes tissue hypoxia due to decreased perfusion beneath the foam which stimulates angioneogenesis and local vasodilatation due to release of nitric oxide.[7-9] There is a controversy regarding the optimal pressure application for VAC dressing. The animal model study showed increased granulation tissue formation with 125 mmHg vacuum compared with low (25 mmHg) or high (500 mmHg) vacuum suction.[10] So we applied negative pressure of 125 mmHg, which is considered as an optimal pressure for VAC dressing.

Many studies on different wounds suggests that VAC may be more economical as compared to conventional wound care methods as it requires fewer dressing changes and lesser reconstructive options for wound healing.[11,12] The KCI Wound VAC system (Kinetic Concepts, Inc, San Antonio, TX) and other commercial vendors providing negative pressure therapy for wounds that are expensive and may not be available everywhere. The KCI type of VAC dressing costs about 9000-10000 Nepali Rupees per unit dressing. So, a country like Nepal and its citizens could not purchase these types of VAC dressing system. The authors decided to minimise its cost and VAC dressings system can be done on basis of the available resources in our own setup (Figure 1). The cost of the modified VAC dressing system is 2000 Nepali Rupees (17 US Dollar) per unit which is five times less than KCI system. But in view of treatment outcome, it equally works and the results are good and acceptable. In developing country like Nepal, the use of such low-cost VAC dressing is more economically beneficial for the patients with complicated wounds.

The VAC system benefits the process of wound healing in chronic and acute wounds with less morbidity and hospital stay. Multiple techniques were used to close wounds for primary or delayed wound closure.[13-15] But in case of complicated wound with comorbidities diseases as we found in present study VAC dressing could easily manage all these complicated wounds without complications.

CONCLUSION

Vacuum-assisted closure dressing is one of the easy and efficient options for wounds care. This procedure can manage most complications at low-cost and thus becomes highly beneficial in a developing country like Nepal.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr. Dipshikha Bajracharya, Dr. Abhinav Vaidya, Dr. Naresh Manandhar, Dr. Apar Lamichhane, Dr. Sangam Rayamajhi, and Ms. Pratibha Khanal for their valuable support.

Conflict of interest: None
Source(s) of support: None

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