Original Article

VACUUM ASSISTED CLOSURE VERSUS CONVENTIONAL DRESSINGS IN TREATMENT OF OPEN UNTIDY WOUNDS

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Objective: To compare the vacuum assisted closure versus conventional dressings of wounds in terms of mean duration of wound healing and change in wound surface area.

Methods: Duration of study was 6 months. It was carried out between April 7, 2012 and October 7, 2012. A total 100 adult patients of either gender with open wounds were admitted and managed as indoor patient. The wounds were initially excised surgically. Patients were divided into two groups. Group 1 includes the patients whose wounds were managed with modified vacuum assisted closure (MVAC) therapy. Group 2 or Gauze group included patients whose wounds were managed with conventional gauze dressings. The variables of study were mean duration of spontaneous healing/ becoming graftable and change in wound surface area in cm^2.

Results: Out of 100 patients, 73 (73%) were males while 27 (27%) were females. Mean duration of wound healing in VAC group was 14.04 ±1.41 whereas mean duration of wound healing in Gauze group was 9.12 ± 2.43. Independent samples t-test was used to compare duration of wound healing in both the groups which was statistically significant (p-value 0.001). Mean change in wound surface in VAC group was 25.66 ± 66.0 whereas mean change in wound surface in Gauze group was 7.2 ± 6.97. Independent samples t-test was used to compare mean change in wound surface which was statistically significant (p-value 0.001) in both the groups.

Conclusion: The study concludes that the modified vacuum assisted closure was more safe and efficacious than moist wound therapy for the treatment of open untidy wounds. Modified Vacuum Assisted Closure therapy of wounds promotes early healing resulting in significant decrease in wound surface area in lesser time period.

Keywords: Wound, Vacuum Assisted Closure, Conventional Dressings.

Introduction

Wounds contribute a major percentage of the patient managed at the Department of plastic surgery. They are often associated with significant morbidity. The management of wounds poses complex and difficult challenge for the plastic surgeon. The patients with problematic wounds constitute a significant workload for health care organizations. Successful management of these wounds require adequate knowledge of the wound etiology, wound bed preparation and the definitive surgical procedures such as grafts and flaps which are employed to resurface the wound.[1,2,3] Wounds are caused by variety of causes like trauma, malignancy, osteomyelitis , burns, diabetes, and vascular diseases. Wounds could be classified into acute and chronic based on duration. But the most practical classification is given by Rank and Wakefield which divide wound into tidy and untidy. Tidy wounds are inflicted by sharp instruments and contain no devitalized tissue. Untidy wound results from crushing, tearing, avulsion, vascular injury, or burns and contain devitalized tissue. The surgeon's main objective is to transform untidy to tidy by removing all infected and necrotic tissue. [4,6] The ideal intrinsic wound healing environment as proposed by winter is moist, uninfected with a good blood supply containing the correct balance of inflammatory mediators. Recently wound treatment is oriented towards creating a wound environment that will enhance blood flow in the wound bed to promote healing and allow surgical intervention to cover the wound.[2,3] The choice of one over another is best made by considering wound characteristics and treatment goals. The goal is clean wounds that are to be closed primarily or are granulating well. In general, hydrogels, films, and composite dressings are best for wounds with light amounts of exudates; hydrocolloids are used for wounds with moderate quantities; and alginates, foams, and NPWT (Negative Pressure Wound Therapy) are best used for wounds with heavier volumes of exudate. [7,9] NPWT is a type of vacuum dressing to promote healing in acute or chronic wounds and it also promotes healing of

second and third degree burns. It was first used by Fleischmann et al in 1993, following successful use of this technique in 15 patients with open fractures. It is also beneficent for diabetic foot ulcers and management of the wound dehiscence after laparotomy.[28, 29] Vacuum Assisted Closure (VAC) is a technique in which controlled negative pressure of a vacuum is used so that infectious material and other fluids are sucked out of the wound. A key component to the initiation of healing process is thorough debridement. The use of Vacuum assisted closure therapy in concurrence with debridement of the affected area increases the frequency of healing. [12] But VAC is costly and requires expert personnel. [13,16] Therefore Modified Vacuum Assisted Closure (MVAC) therapy was invented as it is a simple, cheap, having marked clinical benefits and material used in this technique is easily available material in local market .[17,18] There are few studies on comparison of negative pressure wound therapy(NPWT) and moist wound dressing in treatment of open untidy wounds.[19] The present study was designed to compare the efficacy of Modified vacuum assisted closure with the conventional moist wound dressing in treatment of open untidy wounds in terms of duration of wound healing and change in wound surface area and hence evolve actionable evidence base that could guide our wound management strategies in future patients.

Methods

This randomized control trial performed in department of plastic and reconstructive surgery, Pakistan Institute of Medical Sciences (PIMS) Islamabad. Study was conducted between April 7, 2012 and October 7, 2012. Patients with 13-60 years of age having open untidy wound were included in this study. All the patients having evidence of malignancy, osteomyelitis, or presented with exposed bone, tendons, nerve or vessel were excluded from study.

Data Collection Procedure:

All patients were admitted in Plastic and Reconstructive surgery ward from outpatient department (OPD) and emergency department. The study protocol was approved by the hospital ethics committee. Informed consent was taken from each patient. The dressings were applied by a team comprising of the trainee researcher and 4th year resident of same department supervised by consultant. The patients were divided randomly in two groups by lottery method. In Group 1 patients Modified vacuum assisted closure (MVAC) therapy was used for wound dressing while Conventional gauze dressing was used in 2nd or Gauze group. Necessary wound debridement and toilet was done was done for slough or necrotic tissue before the application of dressings. Wound irrigated with normal saline. A swab for culture was taken before wound irrigation with normal saline and surgical debridement. Prior to application of the drape, the peri-wound skin was prepared and mopped dry. Intravenous antibiotics were given empirically and then according to culture and sensitivity report. Wounds were monitored closely during the hospital stay. In both groups the treatment with vacuum assisted closure therapy or Conventional dressings was continued for 03 weeks and wound size reduction and healing documented by gross examination of the wound. Duration of healing was taken in days while wound surface area was measured in cm2. The wounds were subsequently managed with skin grafts.

Modified Vacuum assisted closure (MVAC):

This type of dressing was used in group 1 patients as shown in figure 1. Wound was prepared by irrigating with normal saline and if necessary surgically toilet was done for slough or necrotic tissue. Sterile, open cell-foam dressing which was gently placed into wound cavity. Open-pore, reticulated 5 mm thick foams were used as they are the most effective at transmitting mechanical forces across the wound and provide an even distribution of negative pressure over the entire wound bed to aid in wound healing. A drainage tube was placed in the wound followed by dressing with sterile gauze pieces and application of occlusive transparent film over the whole assembly. The drainage tube was connected to a suction machine. Intermittent negative pressure ranging from 50 to 125 mmHg was applied so that every 15 minutes, the suction was stopped for five minutes. The dressing (foam plus drapes) was changed every 48 hours.

Conventional Dressings:

These type dressings were used in group 2 patients. Wound was washed with Pyodine soaked gauze pieces in initial 48 hours then twice daily dressings of normal saline soaked gauze were applied.

Results

Total 100 patients were included in this study. Gender and age distribution are shown in **Fig 1** and **Table 1**. Sixty two percent patients were in the 3rd and 4th decades of life. Majority of patients were from

Overall the size of wounds reduced in both groups. Baseline mean wound surface area in MVAC group was 56.04±90.10cm^2 and it reduced to 30.38±54.02cm^2 after 3 weeks. Paired samples t-test was used to compare the size difference and it was statistically significant (p-value 0.024). In gauze group initial size was 55.26±90.07 cm^2 and after 3 weeks it becomes 48.06±83.10 cm^2. Similarly paired samples t-test is also applied in this group but it was not significant statistically (p-value 0.454) . Mean change in wound surface in MVAC group was 25.66±66 cm^2 whereas mean change in wound surface in Gauze group was 7.2±6.97 cm^2. Independent samples t-test was used to compare mean change in wound surface area in both groups which was statistically significant (p-value 0.001). Co- amoxiclav was the most frequently instituted antibiotic

In MVAC group, 40% (n=20) patients had graftable/ healed wounds on completion of two weeks treatment while the remainder 60% (n=30) of the patients had graftable wounds at the end of 03 weeks treatment. In contrast to this, in the Gauze group, only 8 %(n=4) patients had graftable/ healed wounds on completion of two weeks treatment while in the remainder 92%(n=46) of the patients the wounds were graftable at the end of 03 weeks treatment. Chi-square test was used to compare time of spontaneous healing at 2nd week and 3rd week in both the groups which was statistically significant (p-value 0.001) in both the groups.

Mean duration of wound healing in MVAC group was 14.04±1.41 whereas mean duration of wound healing in Gauze group was 9.12±2.43. Independent samples t-test was used to compare duration of wound healing in both the groups which was statistically significant (p-value 0.001).

Discussion

Vacuum assisted closure therapy is a novel method of wound healing. It has several advantageous features over conventional treatment.

In our study, we included a spectrum of patients with open untidy wounds including both acute and chronic. Majority of our patients were relatively young males. Males are more frequently involved in outdoor activities and hence more prone to sustain different wounds secondary to road traffic accidents, falls, firearm injuries and blasts etc. Predominant involvement of young males further amplifies the grave implications of such disabling injuries. Male predominance and more frequent involvement of younger population is well documented in the context of trauma in general. With increasing civil violence, we are receiving increasing number of patients with blast injuries as well.[20]

In our study duration of the wound healing in terms of spontaneous closure or becoming graftable was one of our outcome measures. In this context we found that the wound treated with VAC had faster healing as compared to the gauze treated wounds. Others published studies have also shown faster healing with VAC therapy.[21-23] A variety of factors have been described to account for this accelerated wound healing. VAC therapy continually decontaminates the wound and drains the wound surface of exudates, which contain large amounts of proteases. These would normally inhibit fibroblastic division, collagen production, and cell growth. Fluid removal helps with localized edema that otherwise cause an increase in interstitial pressure with consequent occlusion of microvasculature and lymphatics, decreased nutrient, and oxygen delivery. Protein degradation enzyme is released with metabolic waste accumulation and increased bacterial colonization, which causes capillary damage and hypoxia. VAC therapy also provides a moist environment to promote formation of granulation tissue, which allows for a smoother pathway to re-epithelialize the wound surface. Angiogenesis is also stimulated, which improves tissue oxygenation and tissue reconstruction. [24,25] Mechanical forces exerted on wound surface by low pressure suction are also important. This mechanism mimics the stretch-induced cell proliferation typically found in tissue expansion phenomenon observed elsewhere in the body. [26-27]

Change in the wound surface area with the treatment modality employed, was our other main outcome measure. In this regard we found that the wound treated with VAC had significantly greater reduction in wound size than those wounds treated with gauze dressings. Our observation conforms to several published studies.[1,22,23,28-30]

In our study we found VAC therapy to be convenient for both the patients as well as surgical staff. One major advantage of vacuum therapy is the reduction of the number of dressing changes to once every 48 hours instead of twice or more every 24 hours as in conventional therapy. The reduction of dressing changes leads to an improved patient compliance as the patient suffers less often pain and inconvenience. Besides this, less frequent dressing changes, result in reduced nursing time and thus reduced staff costs for vacuum therapy as compared to conventional therapy: also

Results

Total 100 patients were included in this study. Gender and age distribution are shown in **Fig 1** and **Table 1**. Sixty two percent patients were in the 3rd and 4th decades of life. Majority of patients were from the twin cities of Islamabad and Rawalpindi while remaining were from upper Punjab, Khyber Pukhtoonkhwa (KPK) and Gilgit Baltistan. The causes of wounds were road traffic accidents (RTAs) in 68 %, firearm injuries (FAI) in 24 % and fall from height in 8 %. The wounds were observed on different body sites and included feet, thighs, upper limbs, chest and abdomen / back. **Table 2**

The wound surface area ranged from 9 cm^2 to 500 cm^2. Reduction in the size of wounds was statistically significant in the MVAC group patients as determined on gross inspection of the wounds on weekly basis. At the start of the study the mean wound sizes or surface area in the MVAC group and Gauze group were 56.04±90.10 cm^2 and 55.26±90.07cm^2 respectively. At completion of one week treatment the mean sizes in the two groups were 46.66±78.50 cm^2 and 52.70±87.00 cm^2 respectively. At completion of two weeks treatment the mean sizes in the two groups were 38.94±70.43 cm^2 and 50.82±85.11 cm^2 respectively. At completion of three weeks of treatment the mean sizes in the two groups were 30.38±54.02 cm^2 and 48.06±83.10 cm^2 respectively. Independent samples t-test was used to compare size of wounds at baseline and 1st week in both the groups which was statistically not significant (p-value 0.917 and p-value 0.720) respectively as shown in **table III.** Similarly Independent samples t-test was used to compare size of wounds at 2nd week and 3rd week in both the groups which was statistically significant (p-value 0.029 and p-value

Fig-I: Method of application of MVAC therapy

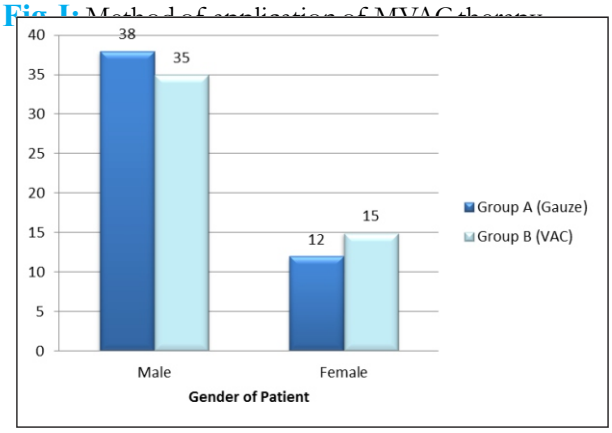

Fig-I: Gender distribution of the patients (n=50 each group)

Table-1: Age distribution among the patients (n=50 each group).

	Age	VAC Group n(%)	Gauze Group n(%)
	13-20 Years	6 (12%)	7 (14%)
	21-30 Years	13 (26%)	13 (26%)
Age Groups	31-40 Years	17 (34%)	18 (36%)
	41-50 Years	13 (26%)	7 (14%)
Total	51-60 Years	1 (2%)	5 (10%)

Table-2: Location wise distribution of the wounds (n=50 each).

	Age	VAC Group n(%)	Gauze Group n(%)
	Feet (left/right)	21 (42%)	22 (44%)
	Thights	6 (12%)	5 (10%)
Site of wounds	Upper limps	11 (22%)	15 (30%)
	Chest	15 (10%)	3 (6%)
	Abdomen/ back	7 (14%)	5 (10%)

Table-3: Reduction in the size of wounds in the two groups (50 patients in each group)

Size of wounds (cm^2)	VAC Group Mean±SD	Gauze Group Mean±SD	P-value
Baseline measures	56.04±90.10	55.26±90.07	0.917
1st week	46.66±78.50	52.70±87.00	0.720
2nd week	38.94±70.43	50.82±85.11	0.029
3 week	30.38±54.02	48.04±83.10	0.005

Hospitalization costs are reduced, due to on average shorter duration of therapy needed for vacuum therapy as compared to conventional therapy .

In our study we found VAC therapy to be more economical . Owing to its low cost, VAC therapy can provide an economical alternative to the other available costly local wound management measures. Such economic implications of wound management are particularly important in the context of our poor patients. Cost effectiveness has also been reported in terms of shortened hospital stays, and decreased overall medical cost in the published literature. [30,32]

In our study we additionally found VAC therapy to be more comfortable for patients as well as the surgical staff. It obviated the need for daily dressing changes. Similar findings have been reported by other studies as well. [32, 33] In our study we observed shorter hospital stay among patients treatment with VAC therapy. A study done by Saziye et al found a particular decrease in the length of hospital stay when compared with the conventional treatment method.[34] However Ko et al [35] did not found similar results with any significant difference in length of stay and treatment duration. Some complications like erosion, eczema and increased body temperature were encountered during vacuum therapy but these are reversible. Erosion of adjacent tissue can be prevented by application of pressure relieving material underneath the tubes. The reaction of the peri-wound area (i.e. maceration and eczema), solved by placement of alginates underneath the adhesive dressing. increased body temperature due to clogging of the system solved by changing the foam dressings.

Pain at wound site during application and removal of foam/gauze occurred with both therapies. It was overcome by analgesics, injection lidocaine underneath the sponge and nonadherent dressing placement at wound base. [36]

Conclusion

Our study concludes that the vacuum assisted closure with the conventional moist wound dressing in treatment of open dirty wounds was more efficacious in terms of duration of wound healing and change in wound surface area. Vacuum Assisted Closure therapy of wounds promotes early healing resulting in significant decrease in wound surface area in lesser time period so that wound is healed or graft may be applied.

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