



ORIGINAL RESEARCH PAPER

General Surgery

ADVANTAGAE OF NEGATIVE PRESSURE WOUND THERAPY (VACUUM ASSISTED CLOSURE) IN DIABETIC FOOT ULCER

KEY WORDS: Diabetic ulcers, NPWT, Vacuum assisted closure

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ABSTRACT

Diabetes affects more than a 100 million people worldwide. Around 10.5% of Americans and 10.9-14.2% of Indians are diabetics, and therefore susceptible to its complications of microangiopathy, neuropathy and poor wound healing, all of which contribute to high incidence of ulcers. These ulcers are developed mainly in the lower extremities after minor injuries which worsens due to paraesthesia and negligence. Management of these ulcers require systemic management of diabetes and its complications in these patients.

INTRODUCTION

Argenta and Morykwas were the first to report Vacuum Assisted Closure of wounds in 1997, wherein removal of oedema, production of early granulation tissue and softening of surrounding tissue facilitating early wound healing and skin grafting were observed [1]. Vacuum dressing involved thorough debridement, adequate haemostasis and application of sterile foam dressing with the machine delivering negative pressure at 50 to 125 mmHg. The advantage of NPWT is decrease in wound volume, depth, treatment duration and cost [2]. NPWT also enables earlier secondary closure of wound and skin grafting as compared to conventional povidone iodine or saline dressing [3].

MATERIAL AND METHODS:

Patients from age group 45-72 years selected for this study. All patients were suffering from type II diabetes mellitus. Out of 90 patients 67 were chronic and 23 were newly detected diabetes mellitus. All selected patients had bad infected wounds, necrotising fasciitis or abscess formation on lower extremities. Out of the 88 patients, 44 were randomly assigned to vacuum therapy and 44 to conventional 7.5% povidone iodine dressing. Proper consent was taken from patients before including them in the study.

All patients underwent baseline hemogram, Fasting and Post prandial blood sugar levels, HbA1C levels, lipid profile, kidney and liver function test.

Radiological X rays of relevant bones and joints done to rule out osteomyelitis, Arterial colour doppler of involved limb done to exclude atherosclerosis and thromboembolic blocks. Co morbidities and glycaemic control were addressed during the admission. Patients underwent complete neurological examination and ophthalmological evaluation.

All wounds were surgically debrided thoroughly under suitable anaesthesia before subjecting them to either group.

Patients subjected to vacuum Dressing were given NPWT for 6 continuous days and wounds were opened on seventh day. In 20 patients VAC applied second time for 6 more days due to depth of the wound and inadequate granulation tissue. The control group was given daily povidone iodine dressing. Broad spectrum antibiotics were administered which were later changed according to pus or tissue bacterial culture and antibiotic sensitivity test.

Vacuum device consisted of the following parts, 1. Sponge, 2. Semipermeable dressing, 3. Tubing, 4. Vacuum machine. The pressure applied was 50 to 125mmHg, intermittently.

The vacuum machine had a canister attached to it that collected the effluent from the wound. Canisters were changed once filled with effluent, with deeper wounds requiring more frequent changing than comparatively superficial ones. NPWT dressing was done under aseptic precautions. Patients and relatives were educated about the basic working of the setup, and to report if the machine stopped working or if the effluent was excessive. They were also taught to change the canister and to disconnect the tubing temporarily when they want to get mobilised.

Inclusion criteria:

Any non-healing wound in a diabetic patient, including post traumatic ulcers, post incision and drainage of abscess, post debridement.

Exclusion criteria:

Wounds with critical limb ischemia and non-diabetic wounds weren't included in this study.

RESULTS:

At the end of 6 days, patients subjected to vacuum dressing had

1. Decreased depth of the wound,
2. Decrease in total surface area of the wound,
3. Decreased discharge from the wound,
4. Healthy granulation tissue formation,
5. Earlier skin grafting or secondary closure,
6. Decreased in surrounding tissue oedema, in fact almost normal surrounding area of all ulcers,
7. Decreased duration of hospital stays.

Table 1. Gender distribution

	Male	Female	Total
Intervention	36	09	45
Control group	36	9	45
Total	72	18	90

Mean age of case group was 58.5 years in both the groups. 80% of patients were males, 20% patients were female.

Table 2. Significant decreased in depth and growth of healthy granulation tissue on seventh day

Wound healing	Intervention group (VAC)	Control group
In depth size	100%	40%
Growth of healthy granulation tissue	70%	45%

There was more than 50% decrease in depth of the wound in a VAC dressing group in all patients, while only 40% of patients in control group had such a significant decrease in depth of

the wound after first week.

Table 3. Average number of days for which wound is ready for closure/SSG

Days	Intervention group (VAC)	Control group
Up to 14 days	45 (100%)	20 (44.44%)
14 to 28 days	0	25 (55.55%)

Average number of days needed for skin grafting or secondary closure was 14 in NPWT group compared to up to 28 days in the control group with povidone iodine dressing

DISCUSSION:

Various theories have been postulated about the mechanism of action of vacuum therapy. In vitro studies have revealed that cells allowed to stretch, tend to divide, and proliferate, in the presence of mitogens, whereas retracted cells remain quiescent [4]. NPWT provides a moist environment which is favourable for re epithelialisation, angiogenesis, promotion of formation of granulation tissue and protects the local nerves [5].

There is a decrease in oedema which decreases interstitial pressure and positively affects microvascular occlusion and lymphatic drainage, increasing availability of oxygen nutrients and antibiotics reaching the wound [6].

Wound exudate is high in metalloproteinases, which are unsuitable for healing as they degrade proteins that are not normally their substrate, growth factors, receptors and extracellular matrix proteins. NPWT promotes an improvement in the balance between proteases and their inhibitors [7].

There is an increase in blood flow due to increase in vascular diameter, blood flow velocity and diameter [8]. NPWT promotes early angiogenesis and appearance of granulation tissue. There is a mobilisation of endothelial progenitor cells (EPC), higher beta fibroblast growth factors (bFGF), thus promoting healing [9]. The foam in vacuum therapy transmits a negative force to surrounding tissues, thus deforming extracellular matrix and activating tyrosine kinase and growth and transport genes [10].

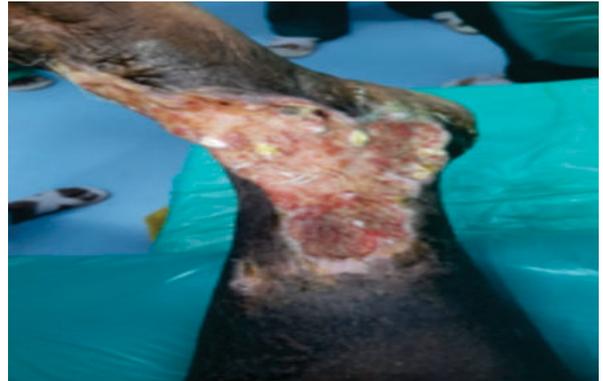
NPWT can be used in post-traumatic, diabetic, pressure, post-surgical dehiscent wounds. However it cannot be used in infected wounds and wounds with critical limb ischaemia. Lower pressures are used in case of decreased perfusion of affected limbs. Debridement prior to application of vacuum dressing with proper antibiotic coverage is imperative, as without debridement, infection will worsen with vacuum application.

Haemostasis should be achieved post debridement and prior to application of vacuum therapy. Also, diabetics due to other associated complications associated with the disease tend to be on antiplatelets or anticoagulants or both and are at a risk of bleeding, therefore monitoring of output from vacuum device is essential.

NPWT gives a significant decrease in wound size, earlier appearance of granulation tissue, earlier closure of wound or grafting is possible. It also decreases hospital stay and morbidity. However, it has its cons, particularly cost of the device (five to six thousand, per application), mild pain or discomfort and irritation of surrounding skin due to barrier layer and abrasions associated with improper application of foam. [11]. Alternatively, a combination of NPWT with topical wound oxygen therapy has also been tried.

CONCLUSION:

Vacuum Dressing yields better results compared to conventional dressing for diabetic ulcers in terms of earlier appearance of granulation tissue, decrease in depth of wound and early wound closure either by secondary or tertiary intention. (NO CONFLICT OF INTEREST)



PICTURE 1: BEFORE VAC DRESSING



PICTURE 2: AFTERVAC DRESSING



PICTURE 3: AFTER SKIN GRAFTING

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