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Original Research Article

Home based negative pressure wound therapy and moist dressing in the treatment of diabetic foot ulcers

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ABSTRACT

Background: Negative pressure wound therapy (NPWT) is a non-invasive wound closure system that uses controlled, localized negative pressure to help heal chronic and acute wounds. The objective of the present study was to compare home based NPWT and moist wound dressing in home care setting with respect to wound healing and time taken for healing among diabetic ulcer patients and the comparison of cost involved for the treatment.
Methods: A hospital based prospective observational study where all patients were presented to the Department of Surgery at MES Medical College with diabetic ulcer between 1st January 2016 and 30th March 2017 were included in the study; ulcer size and surface area were measured using vernier calipers and Wagner's grade between the two groups were evaluated at the time of enrollment.
Results: Complete ulcer healing by primary intention was achieved in 86.8% in home based NPWT group vs. 44.3% in conventional moist dressing group. Average duration taken for healing in home based NPWT patient was 3.03 months and in moist dressing group was 4.58 months. Split skin grafting was needed in 2 patients in HB-NPWT group vs. 7 in moist dressing group. 9.3 hospital visits in HB-NPWT group vs 136.8 sessions in moist dressing group.
Conclusions: The present study states that NPWT is superior to conventional moist dressing for the management of chronic diabetic foot ulcers. Cost is approximately 1/10th of standard NPWT.

Keywords: Home based negative pressure wound therapy, Moist dressing, Diabetic foot ulcer

INTRODUCTION

The Centers for Disease Control and Prevention estimated the prevalence of diabetes in the United States to be 20.8 billion by 2005.[1] India is considered the "diabetic capital of the world" alone currently which counts over 35 million people bearing diabetes. This has been estimated to touch 73.5 million by the year 2025.

Negative pressure wound therapy (NPWT) is a non-invasive wound closure system that uses controlled, localized negative pressure to help heal chronic and acute wounds. It was first described by Charikar et al as an experimental technique for treating subcutaneous fistulas.[2] Today, NPWT is well established for treating trauma wounds, general surgical wounds and diabetic foot wounds. Evidences which support NPWT in the treatment of diabetic foot wound includes numerous prospective and multi-centered randomized controlled trials.[3-5] This system uses latex-free and sterile polyurethane or polyvinyl alcohol foam dressing that is fitted at the bedside to the appropriate size for every wound, and then covered with an adhesive drape to create an airtight seal. The system allows the arteriole to dilate which increases the effectiveness of local circulation assisting in the granulation of proliferation tissue. The method uses excessive fluid from the area which decreases edema. Most commonly, 80-125 mmHg of

negative pressure is used, either continuously or in cycles. Depending on the type of wound, the negative pressure can be initially applied in a continuous mode for 48 hours to remove larger amounts of fluid.

Vacuum assisted closure therapy (VAC) which was also known as vacuum therapy, vacuum sealing or topical negative pressure therapy is a sophisticated development of a standard surgical procedure. Use of vacuum assisted drainage was to remove blood or serous fluid from a wound or operation site. VAC therapy uses two distinct types of foams, with different physical characteristics as the black polyurethane foam and the white polyvinyl alcohol foam.

Objectives

The objectives of the present study were to compare home based negative pressure wound therapy (HBNPWT) and moist wound dressing in home care setting with respect to wound healing and time taken for healing among diabetic ulcer patients and the comparison of cost involved for the treatment.

METHODS

A prospective observational study was conducted with patients having diabetic ulcer at Department of General Surgery, MES Medical College, Perinthalmanna between 1st January 2016 and 30th March 2017. Ulcer size and surface area was measured using vernier calipers and Wagner's grade between the two groups was evaluated at the time of enrollment. Peripheral pulsations and co-morbidities. The patients above the age of 18 years with all types of diabetic foot ulcers having ulcer size >2 cm^2 and patients giving consent for topical negative pressure were included in the study. The patients with active Charcot disease, ulcers resulting from chemical or radiation burns and malignant ulcers untreated and dry gangrene were excluded. 22 patients were enrolled in both groups.

The wounds were thoroughly debrided and the ulcer dimensions as well as surface area were assessed using vernier calipers before both types of dressings are applied. Tissue cultures were obtained. For those in the conventional moist dressing group, dressings were done daily once and in the other group, negative pressure dressings were left undisturbed for 7 days. The patients in both groups were followed up weekly and wounds were compared weekly. Time taken for healing and cost involved in treatment were noted in both groups.

Statistical analysis

Data was entered in Microsoft Excel and analysed using SPSS version 22.

Age, sex, Wagner's grading, risk factors, time taken to heal the ulcer by primary intention, cost involved between the two groups were compared by using Chi-square test.

Table 1: Wagner's grading.[6]

Wagner's grading or classification of ulcer	
Grade 0	Pre-ulcerative lesion or healed ulcer
Grade 1	Superficial ulcer
Grade 2	Ulcer deeper to subcutaneous tissue exposing soft tissues or bone
Grade 3	Abscess formation underneath or osteomyelitis
Grade 4	Gangrene of part of the tissues or limb or foot
Grade 5	Gangrene of entire one area or foot

RESULTS

Table 2 presents the demographic distribution among the patients. Majority was observed in females for HB-NPWT and conventional moist dressing (CMD). Majority patients were in the range group of 40-60 years for HB-NPWT and for CMD were observed in 50-60 years with 7 patients. Diabetes was found to be a common risk factor seen among the HB-NPWT and CMD treated patients. Other risk factors like hypertension (7 patients in HBNPWT and 9 patients in CMD), chronic renal failure (4 patients in HBNPWT and 5 patients in CMD), smoking (12 patients in HB-NPWT and 10 patients in CMD) and peripheral vascular diseases (9 patients in HB-NPWT and 10 patients in CMD) were also evaluated under this study. The location of the ulcer was also noted and recorded. In HB-NPWT treated cases, 12 patients were seen with diabetic foot ulcers in left foot and 10 patients with right foot ulcers and in moist dressing treated cases, 10 patients are seen with left diabetic foot ulcers and 12 patients with right diabetic foot ulcers. The average cost of treatment was found to be more in CMD compared to HBNPWT for treatment of diabetic foot ulcers.

The statistical significance was observed among the two groups and is presented in Table 3. No statistical difference was found for age distribution which showed p value of 0.245 The mean duration of treatment in HB-NPWT is 2.09 months (S.D. 0.8) and in CMD is 4.36 months (S.D. 0.7). The statistical analysis shows t-value -10.209 and p value <0.009 showing no significant difference. Wagner's grading was done and study results are recorded as Grade 1 (2 patients in HB-NPWT and 4

patients in CMD), Grade 2 (12 patients in HBNPWT and 12 patients in CMD) and grade 3 (8 patients in HBNPWT and 6 patients in CMD). Statistical analysis shows Chi-square value as 0.952 and p value as 0.621 with no significant difference detected. Statistical analysis for location of ulcer shows p value as 0.763 which showed no significant difference. The incidence of amputations in the NPWT was lower than that in control groups. 8.18 hospital visits were made in HB-NPWT group vs. 130.91 sessions in CMD group. For Wagner's grading, no statistical difference was found.

There was significant difference among complete ulcer healing between the two groups ($p<0.01$). Complete ulcer healing by primary intention was achieved in 86.8% in HBNPWT group vs. 44.3% in CMD group. Split skin grafting was needed in 2 patients in HB-NPWT group vs. 8 in CMD group.

Table 2: Demographic distribution (n=22).

Demographic characteristics	HBNPWT	CMD
Sex		
Male	7	5
Female	15	17
Age (in years)		
<30	1	2
30-40	2	3
40-50	6	4
50-60	6	7
60-70	4	4
70-80	3	2
Risk factors		
Diabetes	22	22
Hypertension	7	9
Chronic renal failure	4	5
Smoking	12	10
Peripheral vascular disease	9	10
Wagner's grading		
1	2	4
2	12	12
3	8	6
Location of ulcer		
Left	12	10
Right	10	12
Cost of therapy (in rupees)		
Cost per session	452.8/- (consumables) 500/- (procedure cost)	140.78/-
Cost per week of treatment	952.8/-	803.46/-
Cost of suction machine	3500/- (6000/-)	Nil
Total average cost of treatment	7,795.64/-	18,429.38/-

HBNPWT: Home based negative pressure wound therapy; CMD: Conventional moist dressing.

Table 3: Comparison of the parameters used in the procedures.

Sl. No.	Procedure	Mean±S.D.	Chi-square
Age (in years)	HBNPWT	56.19±13.7	t=1.179; p=0.245
	CMD	51.23±13.9	
Time	HBNPWT	2.09±0.8	t=-10.209; p<0.009
	CMD	4.36±0.7	
Number of sessions	HBNPWT	8.18±3.4	t=-28.746; p<0.001
	CMD	130.91±19.7	
Cost of therapy (in rupees)	HBNPWT	7.804±329.35	t= -11.450
	CMD	1.843±2778.79	

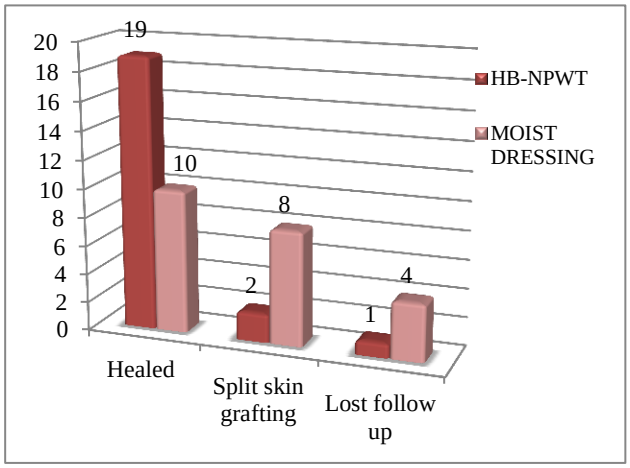

Figure 1: Healed and split skin grafting among the two groups.

DISCUSSION

NPWT removes edema and chronic exudate, reduces bacterial colonization, enhances formation of new blood vessels, increases cellular proliferation and improves wound oxygenation as the result of applied mechanical force. VAC was also called as vacuum therapy, vacuum sealing or topical negative pressure therapy was a sophisticated development of a standard surgical procedure. The present study was carried out to compare HBNPWT and CMD in home care setting with respect to wound healing; time taken for healing among diabetic ulcer patients and compared the cost involved for the treatment. The study conducted by Blume et al showed that NPWT with 58±12 years which was in contrast to the present study.[7]

The study by Sharma et al, measures as a result variable, the time in reaching is complete in wound closure in chronic diabetic ulcers with the use of NPWT.[7] The mean duration of treatment in HB-NPWT was 2.09 months and in CMD was 4.36 months whereas the study conducted by Sharma et al showed the time required for ulcer healing in 41.2 days.[8] The studies carried out by Nather et al, Borgquist et al, Huang et al supports the present study that NPWT is superior to CMD for the management of chronic diabetic foot ulcers.[9-11] NPWT significantly decreases the time to complete wound healing, hastens granulation tissue formation and reduces the ulcer area compared to CMD. The study was supported by James et al.[12]

CONCLUSION

Home based indigenous technique of NPWT produce clinical response comparable to standard NPWT. Cost is approximately 1/10th of standard NPWT. No need of hospitalization as it is home based, which further decreases additional costs. Allows freedom of mobility during the 'negative pressure-off' intervals; increased psychosocial support and decreases the need of secondary procedures like split skin grafting.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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