



A Study on Outcomes of Negative Pressure Wound Therapy in Wound Healing Among Distinct Group of NSTI Patients

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ABSTRACT:

Introduction-Necrotizing soft tissue infection (NSTI), is a rapidly progressing, life threatening condition, and requires prompt diagnosis and management, primarily involving surgical debridement leaving behind a raw area to be further managed. **Methodology-** The prospective study was conducted in the Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram on all patients admitted with NSTI undergoing surgical debridement.. Sample size was 20, calculated using G Power software consisting 10 patients in study group ie, Group I -NPWT and 10 patients in control group ie, Group II - CPID. Association between qualitative variables will be analyzed using the chi square test. Association between quantitative variables was analyzed using an independent sample t test. Significance level will be fixed at a p value of <0.05. **Results-** Average age of patients in study group was 53.6 years while in conventional dressing group it was 52.8 years. Male to female ratio was high in both groups with 100% males in control group and 90% males in the study group. Most common type of NSTI observed in present study was traumatic cause (70%) & infective cause (30%). **Conclusion-** Negative Pressure Wound Therapy (NPWT) is presently being recommended as the treatment of choice for chronic ulcers.

Introduction

Necrotizing soft tissue infection (NSTI), is a rapidly progressing, life threatening condition, and requires prompt diagnosis and management, primarily involving surgical debridement leaving behind a raw area to be further managed. Negative pressure wound therapy (NPWT) is now an accepted adjunct method used in wound healing but its efficacy in Necrotizing Soft Tissue Infections is less discussed.^{1,2,3} NSTI patients distinct group due to trauma, infective causes with associated comorbidities and septic shock had been studied.^{3,4}

Negative Pressure Wound Therapy (NPWT) is a non-invasive procedure that uses negative pressure to control

and absorb exudate. It prevents internal and external infection of the wound surface through a dressing combined with foam connected to a negative pressure device and vessel. NPWT can prevent cross-infection by controlling several factors that complicate wound healing, and increase peripheral microcirculation, thereby stimulating the formation of new blood vessels. Additionally, it enables faster granulation and re-epithelialization of wounds, reduces bacterial counts, and improves tissue oxygenation.

The study was conducted to validate the efficacy and advantages of negative pressure wound therapy (NPWT) over conventional povidone iodine dressing (CPID) in



the management of wound after debridement of devitalized tissues in NSTI.

Methodology

The prospective study was conducted in the Department of General Surgery, Meenakshi Medical College, Hospital and Research Institute, Kanchipuram from February 2022 – June 2023 on all patients admitted with NSTI undergoing surgical debridement. The study was conducted after approval from Ethical committee. Sample size was 20, calculated using G Power software consisting 10 patients in study group ie, Group I -NPWT and 10 patients in control group ie, Group II - CPID. Inclusion and exclusion criteria were made, only those patients satisfying both those criteria were included in the study. Subjects with age above 18 years, giving consent for vacuum therapy, lower limb post debridement due to NSTI, patients with diabetes, hypertension, AKD/CKD, trauma to lower extremity and post amputation were included in the study. At the same time patients below 18 years of age, wounds due to causes other than NSTI, Malignancy within wounds, dry gangrene/ Diabetic Foots, Osteomyelitis, Wounds with exposed organs, vasculatures, Peripheral vascular disease and with increased bleeding disorders and on anticoagulants were excluded from the study.

Statistical Analysis-Data was coded and entered in Microsoft excel. Data analysis was done using SPSS software version 23.0. For qualitative variable frequencies will be calculated & for quantitative variables mean and SD will be calculated. Association between qualitative variables will be analyzed using the chi square test. Association between quantitative variables was analyzed using an independent sample t test. Significance level will be fixed at a p value of <0.05.

Management of the wound

The wound consequential to surgical debridement was managed in two ways: Group I -NPWT and Group II

CPID, NPWT group: with the device in place, the atmospheric pressure was maintained at -125mmHg.

The dressing application was removed every 5th to 6th day. Wound assessment was done weekly

CPID group: the wound was treated with gauze dressing soaked with 5% Povidone Iodine solution. The dressing was changed one to three times a day based on soakage of the wound. Again wound assessment was done weekly.

Materials Used-The application of topical negative pressure moist dressings needs the following materials. Sterile Sponge, Sterile Tubing Vacuum suction apparatus Transparent semi permeable adhesive membrane sheet Technique of application of NPWT Dressing Under anaesthesia, the wounds were well debrided and all devitalized tissue was removed. Thorough wash was given, leaving behind no pockets of infection. Sterile foam with the surrounding normal skin was covered with adhesive, semipermeable, transparent membrane. A good air seal was thus ensured around the wound along with a drain tube. Distal end of the drain tube was now connected to a device, which provided a negative pressure of -125 mmHg which was applied to the wound, continuously for >20 hours per day for five to six days Once adequate granulation tissue was formed both the groups were subjected to split thickness skin grafting. Both groups were given sensitive/prophylactic antibiotics during the postoperative period. The wounds were reassessed every week After discharge, patients were followed up in the out patient department after one month to assess post skin grafting complications like contractures, itching, pain and infection

Results

Average age of patients in study group was 53.6 years while in conventional dressing group it was 52.8 years. Male to female ratio was high in both groups with 100% males in control group and 90% males in the study group. Most common type of NSTI observed in present study was traumatic cause (70%) & infective cause (30%).



I. Sequential Wound cultures

Predominant organism was found to be staphylococcus aureus followed by pseudomonas and klebsiella

Wound Culture	Group	Absent %	Present %	p-value
POD # 0/1	CPID	0	10(100%)	0.45
	NPWT	1(5%)	9(95%)	
Week 2	CPID	2(15%)	8(85%)	<0.01
	NPWT	3(30%)	7(70%)	
Week 3	CPID	4(35%)	6(65%)	<0.01
	NPWT	6(65%)	4(35%)	

Appearance of granulation tissue

Granulation tissue	Group	Absent %	Present %	P Value
Week 1	CPID	96	4	<0.01
	NPWT	40	60	
Week 2	CPID	68	32	<0.01
	NPWT	8	92	

At the end of 2 weeks, just appearance of granulation tissue in conventional group was 32% as compared to 92% in NPWT group.



Figure 1-Course of NF in RTA



Fig 2-Followup after complete Recovery

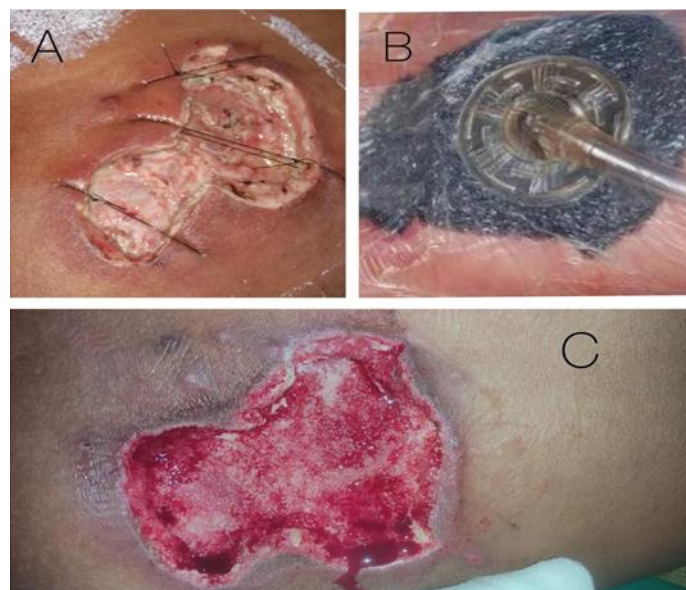
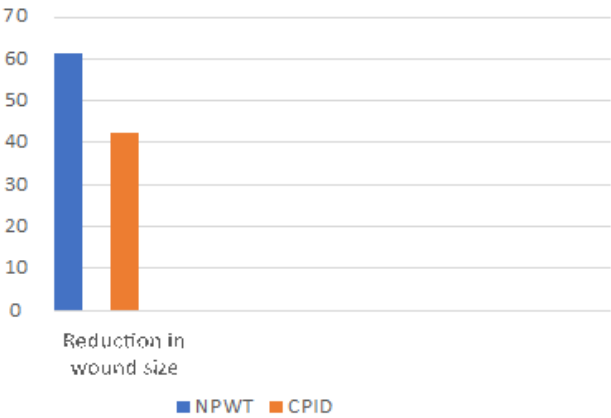


Figure 3- Carbuncle in thigh after NPWT showing granulation tissue; A) pre & C) post vac



III-Reduction in Surface Area

Wound Size	Group	Mean	SD	p-value
POD # 1	CPID	32.32	5.59	0.27
	NPWT	34.2	5.23	
Week 2	CPID	19.39	3.67	<0.01
	NPWT	13.12	3.43	
Improvement (%)	CPID	40.00%	12.70%	<0.01
	NPWT	61.60%	11.20%	



By 2 weeks, mean wound size contraction in conventional group was 40% as compared to 61.6% in NPWT group.



Figure 4- Course of NF in thorn prick diabetic patient; H) Showing reduction in wound surface area post NPWT

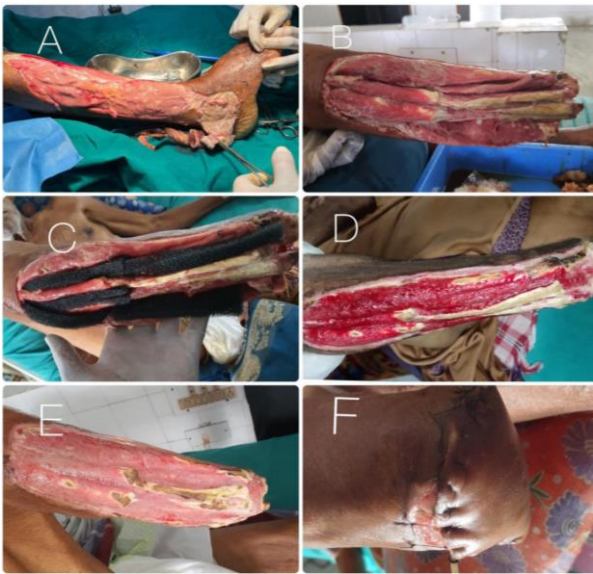


Fig:5 Course of NSTI in septic shock patient D) Showing reduction in wound surface area post NPWT



IV-Length of Hospital Stay

HOSPITAL STAY	GROUP	MEAN	SD	P-VALUE
	CPID	17.23	5.34	<0.05
	NPWT	11.13	4.32	<0.05

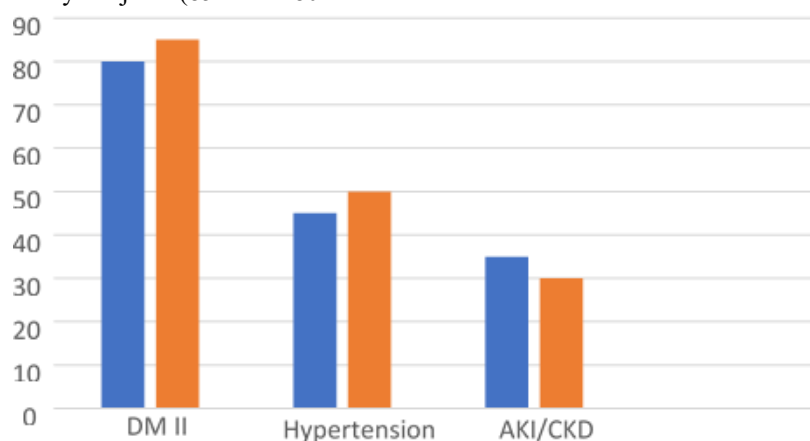
Mean hospital stay was significantly more in cases managed by conventional dressing as compared to NPWT group (17.23 vs 11.13 days). Closure by

Distribution of patients based on co-morbidities

Type II Diabetes Mellitus was the most common co-morbidity observed in study subjects (85% and 80% in

secondary intention or fit for split skin graft was achieved in 52% and 78% patients of Conventional and NPWT group respectively by the end of four weeks.

Conventional and NPWT Groups respectively) followed by Hypertension (45% vs. 50% in both the groups respectively)



Discussion

NPT is considered a new and effective therapy that allows faster healing and granulation results in both the adult and pediatric population. In a randomized study, 77.8% achieved 100% granulation at week 5 versus the control group where only 40% had reached 100% granulation.^{5,6} The use of NPT guarantees in most of its cases an effective and faster healing; with this, we shorten hospitalization time and expenses, reducing the number of cases of complex reinterventions and use of material and human resources and thus demonstrating that it does not increase health spending.^{7,8} Chu H. et al. report how the use of NPT allowed 90% healing in 10 days and complete revitalization in 17 days without complications or infections, resulting in a normotrophic scar.⁹

The average time of NPT is shorter compared to conventional treatment thanks to its effectiveness, thus

reducing the average time of hospitalization. However, Márquez-Espriella C. et al. did not confirm the decrease in hospital stay or the number of cures in the studied cases of the use of NPT in Fournier's gangrene, unlike in cases of diabetic foot and transmetatarsal post-amputees.¹⁰ On the other hand, in some studies, the wound began to be treated with conventional techniques and then NPT was chosen alone or combined with better results.¹¹

Regarding the costs of applying NPT, Dowsett C. et al. calculated a mean total cost per case of GBP 818 and a mean cost of GBP 24.33 in materials and GBP 13.83 in nursing per day.¹² However, in their study, González-Rubio S. et al. tested a cheaper NPT system with which an efficacy similar to that of patented NPT systems was achieved. However, the cost reduction was very significant (MXN 589 with the new design vs. MXN 11,800 with the V.A.C.).¹³



In studies such as the one by Yu L. et al., NPT is used as an infection prevention treatment, reducing surgical site infection and wound complications by 55%.⁸ In addition, in the treatment of device-associated infections, there have been no cases of reinfection after withdrawal of NPT following the incorporation of a protocol: complete removal, cleaning, anterior and posterior capsulotomy and the application of NPT. In addition, Garrigós X. et al. showed how the combination of NPT with intermittent instillation of antiseptics is effective for infected and contaminated wounds, reducing biofilm in open wounds.¹⁴

Restrepo J. et al. and Garrigós X. et al. present several cases of abdominal wounds in which they verify that NPT is the ideal treatment for areas with poor coverage, allowing intimate dermal contact, isolating the area from the outside and facilitating the integration of mesh for the reconstruction of the area.¹⁵ Among the recommended sponges is the non-adherent V.A.C. WhiteFoam dressing; this is also recommended on split-thickness skin grafting as well as on Integra without the need for intermediate dressings, registering an 80–100% adhesion after the first cure (6–7 days after its application). In cases of risk of graft loss due to superinfection such as an ostomy, it is recommended to associate it with V.A.C. GranuFoam Silver.¹⁵

Conclusion

Negative Pressure Wound Therapy (NPWT) is presently being recommended as the treatment of choice for chronic ulcers. It changes the internal wound environment and lowers bacterial load, decreases collection in the wound and increases vascularity within the wound taking advantage of elasticity of peri-wound area. Vacuum dressings are well tolerated and are rapidly becoming the method of choice in wound dressings. But there are very few trials comparing conventional wound dressing and vacuum therapy in Necrotizing soft tissue infections. In case control trial reports that NPWT is found to be effective in NSTIs. It significantly reduces the time to complete wound healing by hastening granulation tissue formation without any increase in the incidence of complication such as bleeding and re-infection, favours rapid wound contraction, better patient compliance as it doesn't need daily change in dressing, reduced pain and decrease in hospital stay. We would like to conclude saying that the negative pressure wound

therapy is superior to conventional dressing in the wound management.

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