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Original Research Paper

Surgery

COMPARATIVE STUDY OF NEGATIVE PRESSURE WOUND THERAPY VERSUS CONVENTIONAL DRESSINGS IN CHRONIC AND TRAUMATIC WOUNDS: A PROSPECTIVE CLINICAL ANALYSIS

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ABSTRACT This prospective observational study evaluated the effectiveness of Negative Pressure Wound Therapy (NPWT) compared with conventional dressings in the management of chronic, traumatic, surgical and diabetic wounds in 200 patients (100 NPWT, 100 conventional). Outcomes assessed included change in wound size, granulation tissue formation, microbiological profile, number of dressings, complications and duration of hospital stay. Staphylococcus aureus was the most common organism isolated initially, and 90% of previously non-sterile wounds became culture-negative following NPWT. Patients treated with NPWT required fewer dressing changes and had shorter hospital stays (approximately 21 days vs 28–35 days) than those receiving conventional dressings. NPWT was associated with faster healing, reduced complication and infection rates, and better patient acceptance, suggesting it is a more effective and practical modality for managing a variety of complex wounds, although larger high-quality randomized trials are still needed to confirm these benefits and evaluate cost-effectiveness.

KEYWORDS : Negative Pressure Wound Therapy, NPWT, Surgical Site Infection , Infection , Diabetes , Post-operative Infection, Wound Care, Type 2 Diabetes Mellitus.

INTRODUCTION

Traumatic, dirty, chronic wound management still challenge for health services. The increasing number of traumatic, dirty and chronic wound's have been a challenge with a high socioeconomic impact and a burden to the individual patient. The management of traumatic dirty and chronic wounds places a burden on health services as it requires manpower. Chronic wounds, traumatic wounds, of the non-healing types, are one of the most common surgical conditions a surgeon comes across. Cost of wound care is the direct medical costs, and do not include the particular individual pain, social and economical disturbance, hospital stay, impaired quality of life of that individual. Keeping all these in mind some important changes in the principles of wound care have taken place in recent decades. Based on these, a wide range of wound care techniques has been introduced. During the last two decades a wide variety of innovative dressings have been introduced. Negative pressure wound therapy (NPWT) is one of these.

For chronic, traumatic and dirty, wound's medical dressings, surgical debridement, topical applications has been developed in last few decades. Most recently developed methods is Negative Pressure Wound Therapy (NPWT) in the early 1990. Therefore, we set out to compare the efficacy of negative pressure wound therapy and conventional wound dressing in patients admitted with chronic, traumatic wound.

The normal healing of wounds

Wound healing is a process consisting of a series of events that overlap and are inter-dependent on each other. The process of healing divided into three phases: the inflammatory phase, occurring immediately after the injury, the proliferative phase (granulation) and, finally, the maturation phase(wound contraction, collagen accumulation).

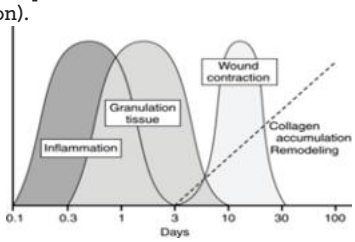


Fig-1 Showing Different Stages of Wound Healing.

(Modified from Clark RA: Cutaneous wound repair. In Goldsmith LA, editor: Physiology, biochemistry and molecular biology of the skin, ed 2, vol 1, New York, 1991, Oxford University Press. In Kumar V, Cotran RS, Robbins ST: Robbins basic pathology, ed 7, Philadelphia, 2003, WB Saunders)

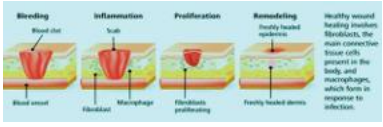


Fig 2. Three Phases of Normal Healing of an Acute Wound. Wound Healing is Initiated in the Inflammatory Phase (days 0-6), and is Followed by the Proliferative Phase (days 4-24) and the Maturation Phase (day 21 Up To 1 Year).
(From Black JM, Hawks JH: Medical surgical nursing, clinical management for positive outcomes, ed 7, St Louis, 2005, WB Saunders.)

Unlike acute wound, a chronic wound remains in the inflammatory or the proliferative phase, and does not cover healing process. Inflammatory phase starts directly at the injury, and lasts for approximately 6 days. Just after the injury, platelets aggregate at the wound site and form a fibrin clot to stop bleeding. Once hemostasis is achieved, the vessels dilatation begins and become more permeable causing an increase in exudate, which leads to the migration of inflammatory cells involved in the phagocytosis of bacteria and debris. The proliferative phase follows the inflammatory phase, lasts about 4 weeks. During this phase angiogenesis occur. collagen and fibronectin, creating a provisional extracellular matrix . The newly formed blood vessels and the extracellular matrix forms granulation tissue. The proliferative phase also include re-epithelialization, in which epithelial cells proliferate and bridge the wound. An undesirable effect of wound contraction is contracture. Maturation the final phase. During the maturation phase, old and dead cells are removed through apoptosis, and changes in the remaining tissue, through the reorganization of collagen, result in a scar formation that has similar properties to the mother tissue. Acute wounds typically follow the phases described above.

However, some wounds do not follow the phases and remain

arrested in the inflammatory or proliferative stage, leading to a chronic non healing wound. Chronic wounds are defined as those remain for more than 4 to 6 weeks, withound following wound healing process.

Conventional Wound Treatment

Important step in wound treatment is to assess the patient well being i.e. good glycemic control, smoking habbit, any edema should be treated, arterial blood circulation assesment. Peripheral nerve function also be tested and if found to be abnormal i.e(diabetic) alongwith dressing of wound. A wound is cleaning and debridement of wound foremost step taken. Debridement and cleaning leads to necrotic, nonviable tissue removal which has been shown to dramatically increases process of wound healing. Next step is to manage inflammation and infection. In chronic wound there is elevation of levels of proteases (matrix metalloproteinases, MMPs) and neutrophil elastase, which leads to increased proteolytic activity which affects the underlying extracellular matrix. Moist environment is essential,as well as exudates formation is vital in wound healing. Therefore selection of wound dressing material, and moisture of wound is important in healing.

There are many wound dressing materials are available in the market, i.e. gauze, films, hydrogels, hydrocolloids, foams, alginates, and antimicrobial-impregnated materials for dressing of wound. As discussed above, re-epithelialization is an most important and crucial step towards wound healing. Its affected by ,glucose level,ischemia,infection which delays wound healing. In the last few decade, a lot new things developed, for example, the importance of bioflim, topical antimicrobial and in the late 1990s NPWT.

NPWT(Negative Pressure Wound Therapy) Mechanics

Clean the wound filled with a porous material, i.e gauze or polyurethane foam, to allow even pressure distribution over the wound. A continous drainage tube is attached above the wound filler, followed by sealing of wound with an adhesive drape.

Connection of drainage tube is with, a vacuum pump and a negative pressure is applied .
In wound care pressures commonly used clinically range from -80 to -125 mmHg. The pump is designed in such a way that it can also be operated in different modes continuous, intermittent, or variable pressure reduction.

Continuous mode is the mode which is used mostly in whole treatment. The vacuum suction is varied, in variable mode but never turned off completely; i.e it ranges from -10 to -80 mmHg. Unlike other mode the vacuum suction is turned on and off in intermittent mode i.e 5 minutes at -80 mmHg, and 2 minutes with off. . Immediately after the application of vacuum pressure the wound contraction followed by wound fluid is drained, and then wound bed is stimulated. NPWT creates a moist environment, modifies blood flow pattern, and neo-angiogenesis. It also helps in reducing in tissue edema and formation of granulation tissue. NPWT of a wound filled with gauze.

NPWT used:
1. In venous leg ulcers.
2. Diabetic foot ulcers.
3. Vascular surgery wounds.
4. Skin grafts.
5. Decubitus ulcers.
6. Burns.
7. Wound dehiscence following abdominal.
8. Thoracic surgery.
9. Traumatic orthopedic and surgical infections.

Goals of NPWT
- To promote rapid reduction in wound volume,
- To promote the growth of granulation tissue and contraction of wound edges
- To manage exudates.
- To prepare the wound bed for transition to another treatment modality.
- To decrease the frequency of dressing change.
- To prevent deterioration of the wound
- To minimize contamination and wound odor by providing a temporary barrier.
- To decrease morbidity and mortality,
- To improve quality of life, and
- To decrease the length of hospital stay.

METHDOLOGY

Aim: The principal aim of work presented in this study was to assess the effectiveness and to determine difference in outcome between conventional and of NPWT dressing.

Objective:

1. To assess the effectiveness in outcome between conventional and of NPWT dressing in terms of following-
1. Change of size of wound
2. Rate of granulation tissue formation.
3. Period of hospital stay.
4. Complication after management

Sample Size: 200 patient (100 with NPWT and 100 with conventional dressing.)

Sample Design: Observational descriptive study with prospective design.

Inclusion
1. Chronic wound due to infection.
2. Traumatic wound.
3. Surgical wound.

Exclusion
1. Necrotic tissue with ulcer.
2. Inadequate debridement of wound.
3. Untreated osteomyelitis.
4. Malignant wound.

Laboratory Investigations:
1. Blood for complete blood count, Urea Creatinine, Liver Function Test, Serum electrolytes (Na+, K+), Fasting and Post prandial blood sugar.
2. Chest Xray PA view.
3. ECG 12 leads.

HOW TO APPLY

STEP 1: Clean wound, debride any necrotic/ eschar tissue if necessary. Wound cleansing should occur with each dressing change before applying NPWT therapy.

STEP 2: Cut smart gauze of suitable size (primary wound contact layer) to mimic the size & shape of the wound bed. Moisten it with distilled or sterile water.

STEP 3: Cut the foam in appropriate size and gently keep it on top of the smart gauze.

STEP 4: Measure 3-4cms away from the border of the intact skin.Trim PU film drape to size. Peel back one side of the layer. Place adhesive side over the wound & remove stabilization layer.

STEP 5: Pull up PU film. Cut at least a 2cm round hole to apply NPWT Track Pad .

STEP 6: Remove blocking layers from NPWT track pad. Place NPWT track pad opening directly on to the round hole of PU film. Apply gentle pressure on NPWT track pad to secure it with the PU film in order to make an air tight chamber.

STEP 7: Connect NPWT track pad tubing to canister tubing. Turn on power of NPWT therapy unit & set mode of therapy & pressure as prescribed by the physician

OBSERVATION AND RESULT

Table 1:- Distribution of Location of Wounds

Location	Frequency	Percentage %
Thigh	41	20.5
Leg	51	25.5

Chest	13	6.5
Abdomen	66	33
Buttock	17	8.5
Hand	12	6
Total	200	100

Table 2: Organisms Cultured From Wound Before Dressing:

Organisms	Frequency	Percentage %
Staphylococcus	106	53
Pseudomonas	35	17.5
Proteus	13	6.5
Klebsiella	9	4.5
Escherichia coli	32	16
No growth	5	2.5
Total	200	100

Table 3 : Organisms Cultured From Wound After Dressing.

Organisms	Frequency	Percentage %
No growth	168	84
Escherichia coli	9	4.5
Staphylococcus	23	11.5
Pseudomonas	0	0
Proteus	0	0
Klebsiella	0	0
Total	200	100

Table-4 Number of Dressing in Group A(NPWT)

Number	Frequency	Cumulative Frequency
Up to 2	14	14
2-4	73	87
> 5	13	100

Table-5 Number of Dressing in Group B (Conventional Dressing)

Number	Frequency	Cumulative Frequency
Up to < 10	17	17
10-15	49	66
16-20	31	97
> 20	3	100

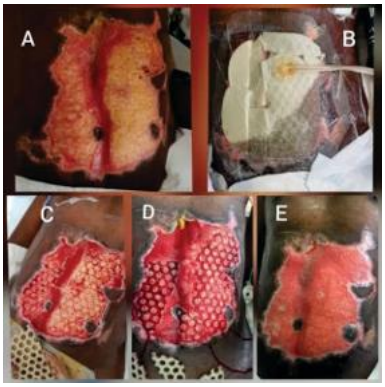
Table-6 Duration of Hospital Stay in Days.

Number	Group A : Frequency	Group B : Frequency
Up to 15	26	6
16-20	34	13
> 20	40	81

Table-7 : Etiology of Wound for Which Dressing Done.

	Frequency	Cumulative Frequency
Surgical	79	39.5
Traumatic	68	36
Diabetic	41	20.5
Pressure sore	11	5.5
Bomb blast injury	1	0.5
Total	200	100

Image Gallary



CONCLUSION

- Our study examines the effect of NPWT and conventional dressing wounds. The preliminary results obtained, indicating decreased wound complications. Some evidence has indicated that the negative pressure wound therapy (NPWT) can significantly reduce the risk of infection of the patients in treatment of open fractures and accelerate their wound healing process.
- The advantage of NPWT over the conventional wound dressings still needs to be proved. High-quality RCTs with detailed clarification of the study procedures, adequate sample sizes and standardized presentation of the results should be guaranteed. The influence of NPWT on the amputation, the fracture healing, and the patient life quality should also be reported to avoid the selective reporting. The value of the cohort studies is limited because of intergroup incomparability in the injury severity.
- This study shows that Negative Pressure Wound Therapy (NPWT) is a more effective method of treatment of Chronic Diabetic Foot Ulcers as compared to Conventional Dressing with 30% faster healing rates, reduced overall complication rates and better patient acceptance.
- NPWT therapy is a recent modality of treatment of wounds. Its introduction has changed the course of management of wounds. Based on the data from the present study and other studies available, NPWT does appear to result in better healing, with few serious complications, and thus looks to be a promising alternative for the management of various wounds. The application of NPWT is simple, but requires training to ensure appropriate and competent use. The cost of NPWT will vary and depend on the length of hospital stay and cost of supplies. There is a paucity of high quality RCTs on NPWT therapy for wound management with sufficient sample size and adequate power to detect differences, if any, between NPWT and standard dressings. More rigorous studies with larger sample sizes assessing the use and cost effectiveness of NPWT on different wound types are required.

SUMMARY

- Management of wounds is always a challenging issue. Delayed healing of wounds is a major problem in the community; besides causing morbidity and disability in the patient, is a burden on our health resources. Therefore is a need for application of newer and advanced modalities in management of wounds. NPWT uses negative pressure to assist wound healing and has a positive impact on wound healing by enhancing granulation tissue formation and wound closure, thus providing a modern wound care system for the poor at an affordable cost.
- Patients affected were most commonly in the age group of 41-60years.
- There was a male preponderance.
- NPWT dressing was done in wounds occurring in a variety of locations like leg and thigh, abdomen, hand.
- Most common organism culture was Staphylococcus aureus.
- 90% of non-sterile pre-vac culture turned sterile after VAC.
- The hospital stay was found to be only 21days for patients with
- NPWT dressing, when compared 28-35 days in conventional group.

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