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Original Article

Negative Pressure Wound Therapy (NPWT) in open wound management: A study of 16 Cases in Orthopaedic Department of Faridpur Medical College Hospital

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Abstract :

Wound management is a major concern in open fracture cases. Negative Pressure Wound Therapy (NPWT) is an advanced method for managing open wounds. It is a topical treatment using sub-atmospheric pressure to increase blood flow, remove bacteria and increase growth of granulation tissue in the wound. The study was performed to evaluate the results of NPWT in patients with open fracture in lower extremity. Using Aquarium pump as an NPWT device, 16 patients were prospectly treated for open fractures in their inferior extremity. Mean patients' age range was 21 to 60 yrs. The patients under study either had suffered from trauma, fall or had post operative wound infection. Many of them had wounds with underlying tendon or bone exposure. Necrotic tissues were debrided before applying NPWT. Dressings were changed every 3rd or 4th day and treatments were continued for 07 to 28 days. Exposed tendons and bones were successfully covered with healthy granulation tissue in all cases, depth of the wounds reduced as well as surface areas. In 12 cases coverage of granulation tissue were achieved and further managed by skin grafting, 4 cases with wound infections were closed with secondary suture. No significant complications were noted regarding the treatment. NPWT was found to facilitate the rapid formation of healthy granulation tissue on open wounds in lower extremity and thus to shorten healing time and minimize secondary soft tissue defect coverage procedures.

Key words : Negative Pressure wound therapy, Open wound.

Introduction :

Wound management in open fracture case is a critical situation, where tendon and/ or bone exposures are commonly associated[1]. The conventional method for wound management is granulation tissue formation followed by wound closure by skin grafting or secondary suture[2]. This method takes longer time and patients experience severe pain during dressing changes[3]. Furthermore it is difficult to form healthy granulation tissue by simple wet dressing when tendons, bones or implants are exposed. Accordingly free flap surgery is required, which needs substantial effort and introduces the issue of donor site morbidity[4].

Negative Pressure Wound Therapy (NPWT) was first described by Argenta and Morikwas. This technique can be used to cover exposed bone, tendon, implant or soft tissue defects without frequent dressing changes, and reduces chronic edema and increases the local blood supply, which enhances the formation of healthy granulation tissue. The purpose of this study was to determine how NPWT helps healing and whether the technique can reduce the need for flap surgery or even save the limb from amputation due to loss of its vitality owing to the limitations of using conventional wet dressing.

Materials and Methods :

Over the one year period starting from August 2011 to July 2012, 16 cases with wounds associated with open fractures in their lower extremities were treated by

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NPWT method by using aquarium pump in the Orthopaedics department of FMCH.

Technique :

In Bangladesh NPWT device is not yet available at market. We used aquarium pump machine instead. Before application the wound was prepared by thorough surgical toileting and debridement of necrosed tissue. In cases of fractures external fixators or plaster casts were applied also. The wound was covered by a thin sheet of polyurethane foam of 4-6 mm thickness. The foam was previously cut according to the shape and size of the wound, keeping 3-5 cm larger than the wound surface. A drain tube was applied over it. Another sheet of foam was applied there over. Then the wound was sealed with transparent cohesive film. When the machine was switched on, the wound was sucked continuously by the pump through the evacuation tube at 100 to 125 mm of Hg. The effluent collected in the collector saline bag through an outlet tube. The dressing was changed every 3rd to 4th days. NPWT was stopped after ensuring coverage of wound by healthy granulation tissue. Skin grafting or secondary suture applied thereafter.

Wound types (acute or traumatic versus chronic) location were noted, and durations, numbers and frequencies of NPWT system were recorded. Wounds were categorized into 5 groups based on degree of exposure and presence of concomitant infection, which was graded from 0-4 (Table I). Final coverage techniques were noted. Furthermore any complications attributable to NPWT treatment were noted.

All the patients were discharged after successful wound closure by partial thickness skin graft or secondary suture. Thereafter the patients were followedup at monthly intervals for at least three months at the outpatient department of the same institution.

Table I: Details of the wound scoring system used

Score (Grade)	Status of wound
0	Closed wound
1	Skin or soft tissue defect
2	Bone, tendon or implant exposure
3	Bone, tendon or implant exposure [any combination of 2 or more]
4	Associated or residual infection

Results :

Patient age was 21 to 60 years. All the patients had open fractures (RTA 6, Crush injury 4, fall from height 2 and post operative wound infection 4). Wound locations were lateral aspect of thigh 2, above knee amputation stump 1, below knee amputation stump 1, lateral aspect of leg 2, medial aspect of ankle 1, posterior aspect of leg 3 and the dorsum of foot 4 cases. 12 patients had either tendon or bone exposure, 2 had exposed metallic implants and 2 had open wound associated with post-operative wound infections.

The mean duration of therapy was 15.62 days (range 7 to 28 days) and dressings were changed 5.5 times on an average. Mean wound size before treatment was 43.31 cm^2 which reduced to 31.75 cm^2 at the end of the treatment. Average wound size reduction was 26.69%. All cases improved their wound status after treatment and the exposed bones and tendons were covered by healthy granulation tissue. All wounds were further managed by PTSG (partial thickness skin graft) or secondary suture.

No complication occurred that could be directly attributable to NPWT such as a deep infection or bleeding. Minor complications include itching and bad odour of the wound.

Discussion :

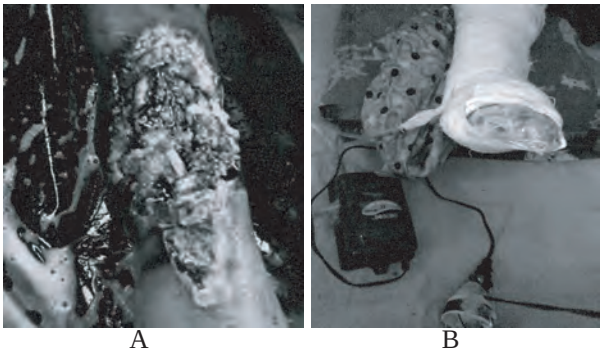
Open wounds in lower extremities are often complicated with significant skin loss, exposures of bones, tendons and/or implants/devices and are associated with wound management difficulties. The rapid formation of granulation tissue and blood vessels are essential for the healing of the wounds. Traditional frequent wet dressing changes (3-4 times per day) are protracted and painful[5]. Furthermore, interstitial fluid from open wound reduces local blood supply and disturbs wound healing due to its collagenase and metalloproteinase enzyme constituents[6]. NPWT keeps the wound free from this collection by continuous suction and In all our patients the wounds were covered with healthy granulation tissues after 5.5 sponge changes (range 2 to 10) without additional flap surgery. De Franzio reported that NPWT enhances rapid granulation tissue formation in 80% of patients as compared with a simple wet dressing. Furthermore, it has been well reported that NPWT provides continuous physical stimulus that enhances new blood vessel and granulation tissue formation[7].

Soft tissue defects in the lower extremities require local or free flap surgery when a skin graft procedure is not applicable due to limited granulation tissue formation[8]. A split thickness skin grafting is not recommended for wounds with exposed bone or neuro-vascular structures, or for wounds involving weight bearing surface of the foot[9].

Table II: Patients and wound details before and after NPWT

No	Age (year)	Sex	Injury	Site	Wound grade (before)	Wound grade (After)	Size (Before) Cm^2	Size (After) Cm^2	Duration (Days)	Additional procedure	Major Complication
1	60	F	Crush injury	Dorsum of foot	3	1	48	35	28	PTSG	Nil
2	25	F	Crush injury	Dorsum of foot	3	1	42	30	21	PTSG	Nil
3	30	M	Fall from height	Medial aspect of ankle	3	1	20	14	10	PTSG	Nil
4	35	M	Crush injury	Lateral aspect of leg	3	1	60	40	14	PTSG	Nil
5	22	M	RTA	Dorsum of foot	2	1	66	55	14	PTSG	Nil
6	46	F	Fall from height	Medial aspect of leg	2	1	40	32	10	PTSG	Nil
7	58	M	Wound infection	Lateral aspect of Thigh	4	1	56	38	28	Secondary suture	Nil
8	48	F	RTA	Posterior aspect of leg	2	1	48	36	14	PTSG	Nil
9	21	M	Crush injury	Dorsum of foot	3	1	22	16	14	PTSG	Nil
10	56	M	Wound infection	Above knee amputation stump	4	1	36	24	21	Secondary suture	Nil
11	60	M	RTA	Posterior aspect of leg	3	1	42	30	14	PTSG	Nil
12	24	M	Wound infection	Lateral aspect of Thigh	4	1	35	20	28	Secondary suture	Nil
13	26	M	Wound infection	Below knee amputation stump	4	1	20	16	10	Secondary suture	Nil
14	28	M	RTA	Lateral aspect of leg	3	1	60	44	7	PTSG	Nil
15	30	M	RTA	Medial aspect of leg	2	1	42	30	7	PTSG	Nil
16	35	M	RTA	Posterior aspect of leg	2	1	56	48	10	PTSG	Nil

PTSG – Partial Thickness Skin Grafting, RTA – Road Traffic Accident



A B

Figure 1 : Crush injury over dorsum of foot in a lady of 25 years.

After debridement of necrotized tissue (A), After setting up of NPWT on first day (B).

C D

Figure 2 : Follow up of NPWT of the same patient.

After 10 days of NPWT treatment (C), After 4 days of PTSG (D).

In a comparative study of traditional dressing and NPWT, the need for free flap surgery reduced by 30%[10]. A remarkable reduction in the requirements of secondary soft tissue operation is believed to be a big advantage of NPWT[10]. Dedmond also reported that wounds of grade 3 with an accompanying open tibial fracture healed without the need for a flap surgery[11]. In deep infected wounds wet dressings are not appropriate because wounds are exposed to atmosphere[12]. On the other hand NPWT only seals the open wounds but evacuates hematomas, exudates and possible pathogens by application of NPWT[13]. Accordingly we consider that, NPWT also reduces soft tissues infection rates[14].

There were no such severe complication attributed to the treatment, minor complications includes itching and bad odour from the dressing. The study has several limitations that require consideration, namely that the size of data was small and there was no control group. Our results add to growing evidence that NPWT is a useful adjunctive treatment for open wounds in lower extremity. The present study, NPWT was found to facilitate the rapid formation of granulation tissue, to shorten healing time, reduce hospital stay and to reduce remarkably the need for additional soft tissue reconstructive surgery. The results of our study coincide with similar studies done on the similar topics elsewhere.

Conclusion :

NPWT is an advanced method for open wound management. In FMCH we are getting benefit out of it. Locally procured aquarium pump is being used as the NPWT device which costs 3 to 4 USD. It reduces the requirement for daily dressing changes thus helps in properly utilizing hospital manpower, it also reduce the patients' hospital stay. We treated some severely damaged limbs which without NPWT might not be salvaged. Our study is a highlight how NPWT helps in managing open wounds in lower extremities.

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