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APPLICATION OF VACUUM ASSISTED NEGATIVE PRESSURE WOUND THERAPY IN POST-TRAUMATIC CONTAMINATED WOUNDS

John Mohd	Post Graduate Department of Orthopaedics , GMC Jammu, Jammu and Kashmir, India.
Hilal Ahmad Malla*	Medical Officer Director Health Services Kashmir, Jammu and Kashmir, India *Corresponding Author
Yashshavani Dass	Post Graduate Department Of Dermatology, GMC Jammu Jammu and Kashmir, India.

ABSTRACT The treatment of open contaminated injury due to trauma is a demanding task especially when there is a fracture associated with loss of soft tissue cover. Many techniques for management of complex contaminated wounds are being studied for their efficacy. Our area of study is concerning the use of Negative pressure wound therapy (NPWT) in grossly contaminated wounds. It results in more rapid and better healing with healthy granulation tissue formation, decreasing the edema and bacterial load, improving local oxygen tension, decreasing the frequency of changing dressing, and permitting less exposure to external environmental and helps in early recovery and rehabilitation, and hence a more economical tool. NPWT can avert the need of multiple surgeries and can suffice as a definitive measure at times. This technology is a major breakthrough in wound healing.

KEYWORDS : Trauma, Negative pressure wound therapy (NPWT), fracture.

INTRODUCTION

Compound fractures associated with soft tissue loss with contamination in the form of organic particles like farmyard injuries and road side injuries with gross intrusion of heavy dirt are a difficult area of trauma to plan and execute the strategy and decision regarding primary and definitive management becomes a matter of great importance in the face of existing emergency scenario. The problem becomes more complicated and equally demanding in case of soft tissue loss over the fracture site with exposed bone. NPWT helps in wound healing in many ways like macrodeformation, microdeformation, decreasing edema by fluid removal, and improving wound environment ,enhancing neurogenesis, angiogenesis, modulation of inflammation, and reducing the load of bacteria. Under negative pressure, the edematous fluid from the extravascular space is removed,improving wound environment and enhancing oxygen tension and reducing the risk of infection along with formation of healthy granulation tissue. In NPWT the wound is first filled with a porous material such as foam or gauze, that facilitates pressure transmission within the wound. The foam should be in contact with the wound bed and edges are sealed. This guarantees uniform negative pressure distribution to every part of the wound. A transparent adhesive layer extends over and adheres to the skin adjacent to the wound. A drain is placed to allow direct contact to the underlying foam through a single and creates a partial vacuum atmosphere. Distally the drain is connected to a vacuum source (NPWT Unit)(1-3). This technique has been developed and popularized by Prof. Louis Argenta (4), Prof. Micheal Morykwas (5) and by Dr Win Flieschmann (6). NPWT results in minimal complication, with skin maceration being the most common (7-10). Total complication rate ranges from 0-18% (4, 11, 12-15). NPWT is a novel breakthrough in wound management to promote faster healing, thereby decreasing the period between debridement and definite surgical closure in large wounds. It provides a moist wound-healing environment.

MATERIALS AND METHODS

This study was carried out on patients who underwent treatment from january 2018 to April 2019 in a tertiary care referral centre Govt. Medical College and Associated Hospitals Jammu, Jammu and Kashmir, India. We followed a group of forty patients with five patients having more than one wound, making the count of wounds equal to forty five. The inclusion/exclusion of patients in the study was determined by factors like wound size, degree of soft tissue loss, location, active infection, need of serial debridement, exposed neurovascular structures in the vicinity of wound, any known skin allergy, and patient compatability.

INCLUSION CRITERIA

1. Wounds over the Extremities (Both upper and lower limbs).
2. Large wounds not amenable to primary closure.
3. Debrided wounds .
4. Wound with soft tissue loss and exposed bone.
5. Compatible patient.

EXCLUSION CRITERIA

1. Exposed neurovascular structures.
2. Wounds bleeding Actively .
3. Past history of Allergic reaction to foam and adhesive material.
4. Extensive skin necrosis.

All patients were given 1.5gm cefuroxime, 500mg amikacin and 100ml metrogyl i.v as prophylactic antibiotics within 30 minutes of commencement of surgery.

The wound is first filled with a porous material such as foam or gauze, that facilitates pressure transmission within the wound. A drainage port is then attached above the porous material and the wound is sealed with an adhesive film dressing. The drainage port is connected to a controlled vacuum pump which maintains negative pressure, usually ranging from -50 to -150 mmHg (16,17). The pressure can be applied in a continuous, intermittent, or variable mode. The most commonly used material is a reticulated open-pore polyurethane (PU) foam. Four basic components of the VAC system comprises of the vacuum pump (negative pressure unit), canister, tubing to connect the dressing to the pump and VAC dressing pack. An alarm system located on the pump rings when the canister is full or in case of leaks or tube blockage or if the desired pressure is not reached. Wound is inspected and surgical debridement is done to ensure removal of all necrotic and devitalised tissues, and hemostasis is achieved. In infected wounds with active pus discharge a culture swab for microbiology should be taken. Before drape is applied the skin area surrounding the wound is prepared by a cleansing agent.

Sterile, open-cell foam dressing is gently placed into the wound cavity. Embedded in the foam is a fenestrated evacuation tube connected to a vacuum pump that contains a fluid collection canister. The amount of pressure applied will depend on which type of foam is used, with the white foam requiring higher negative pressure as it is denser.

The site is then sealed with an adhesive drape. Drapes should adequately cover the foam and tubing and at least three to five centimetres of surrounding healthy tissue to ensure a seal. The dressings were kept intact for 7 days and wound examined on 7th day. Care must be taken when removing the adhesive drape to avoid irritating normal skin immediate to wound. Uniform controlled pressure is applied to all tissues on the inner surface of the wound. The pressure applied should compress the foam dressing. Pump pressures ranging from 50 to 125 mm Hg either continuous or intermittent is used in the therapy. Intermittent delivery consists of a seven-minute cycle of two minutes off and five minutes on, while the negative pressure is maintained. The ideal pressure setting is 125mmHg. Higher pressures of 150 mmHg plus are used for large cavity wounds such as acute traumatic wound, as they produce copious amounts of exudate. The

pressure is set to continuous for the first 48 hours and the pressure is changed as required thereafter. Afterwards the wounds are treated with grafting or normal dressing depending on the dimensions, and wound toilet. After satisfactory dressing patient were discharged and advised further out patient, in patient for follow up [18].

RESULTS

Our study followed forty (40) patients with mean age of thirty eight years (range,25-65 year) and a total of forty five (45)wounds were treated. Mean time used for placing the dressing was fifty five (55) minutes and mean time for total treatment was 40.2 days. Refer to Table no.1 for elaboration.

Table 1: Characteristics of patients and dressings.

Variables	Characteristics	
Sample size	40 patients and total 45wounds	
Age	Range = 25-65 years, mean = 40.2 years	
Sex	Male	35 (87.5%)
	Female	5 (12.5%)
Dressings (NPWT)	Time taken for dressings	Range35-80 minutes; mean 55 minutes
	Drainage volume	Range 20-150ml/d; mean 80ml/d
	Satisfactory	93.3% (112 dressings in 40 patients)
	Unsatisfactory	6.6 %(8 dressings in 5 patients)
		Partial thickness Skin Grafts 84.44% (n=38)
	Wound outcomes	Closure by Suture after undermining and release of healthy wound edges 8.8% (n= 4)
		Healing by secondary intention 6.6% (n=3)
		Local flap 0% (n=0)
Wound size	Range, 3-15 cm	Small (>10cm) (n=10) 22.2%
		Large(≥10cm) (n=35) 87.5%
Length of hospital stay	Range, 25-30 days ; mean= 27.2days	
Duration of NPWT	7-15 days (mean=11 days)	
Complications (out of total 45 wounds)	Skin Maceration (most common)	10 wounds (22.22%)
	Mild Bleeding at dressing change	6 wounds (13.33%)
Treatment time	mean= 40.2 days	

Mode of injury: Road traffic accident was the predominant mode of injury.

Comorbidities : 5(12.5%) patients were having diabetes mellitus, 4(10%) patients were hypertensive, and 3(7.5%)patients had both the diseases.

Follow up: All patients were followed for a period of 9 months.

DISCUSSION

The clinical application of NPWT in the management of contaminated wounds with soft tissue loss and compromise holds a potential benefit in terms of improved as well as faster wound healing with resultant decrease in intermediate period of time till definitive surgical procedure. Besides, the frequency of changing dressing is less, and limiting the exposure of wound to external environmental and helps in early recovery and rehabilitation, and hence a more economical tool. Besides, in some cases it can avert the need of multiple surgeries and can suffice as a definitive measure by shrinking the area of wound. This technology is a major breakthrough in wound healing with significant advantages compared to other conventional methods.

Various proposed mechanisms of action of NPWT are decreasing edema, increase in blood flow, promotion of angiogenesis, reduction of wound surface area, modulation of the inhibitory contents in wound fluid, induction of cell proliferation (19).

Limitation : Though the vacuum therapy is quite economical overall but in terms of monetary cost its still beyond the affordability of a large chunk of patients in our setup, as we don't have the in built hospital based centrally fitted negative suction points in our ward and hence we are solely dependent upon the private sector for the mobile NPWT unit who charge a higher fee comparatively.

CONCLUSION

Our stsudy concluded that NPWT has definite benefit over traditional dressing in the management of grossly contaminated compound injuries. There is formation of healthy granulation tissue and finally better survival of graft palced. Negative pressure wound therapy has made wound healing more economical and saves time and effort.

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