



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL  
OF CURRENT RESEARCH

International Journal of Current Research  
Vol. 11, Issue, 01, pp.210-213, January, 2019

DOI: <https://doi.org/10.24941/ijcr.33728.01.2019>

## RESEARCH ARTICLE

### OUTCOME OF NEGATIVE PRESSURE THERAPY IN TREATMENT OF INFECTED WOUNDS OF LOWER LIMB A RETROSPECTIVE STUDY

<sup>1,\*</sup>Dr. Sakib Arfee, <sup>2</sup>Dr. Abdul Ghani, <sup>3</sup>Dr. Mudasir Rashid, <sup>4</sup>Dr. Imran Yousuf Bhat, <sup>5</sup>Dr. Omeshwar Singh and <sup>6</sup>Dr. Mohammad Azhar Ud Din Darokhan

<sup>2</sup>Associate Professor Department of orthopedics GMC Jammu, Govt. Medical College and Hospital Jammu, Jammu and Kashmir, India

<sup>5,6</sup>Senior Resident Orthopedics GMC Jammu, Govt. Medical College and Hospital Jammu, Jammu and Kashmir, India

<sup>1,3,4</sup>Resident Orthopedics GMC Jammu, Govt. Medical College and Hospital Jammu, Jammu and Kashmir, India

#### ARTICLE INFO

##### Article History:

Received 20<sup>th</sup> October, 2018

Received in revised form

26<sup>th</sup> November, 2018

Accepted 10<sup>th</sup> December, 2018

Published online 30<sup>th</sup> January, 2019

##### Key Words:

Negative pressure therapy,  
NPWT, Infected wounds of lower limbs

#### ABSTRACT

**Introduction:** Infected wounds irrespective of their location are such a burden to the patient and the healthcare which is beyond any description we can make. Presence of infection is a complex problem especially in extremities, which leads to spectrum of complications such as soft tissue loss, exposure of sensitive structures like tendons, nerves, bones etc and even amputation. Infections have always been a matter of worry for the surgeons and especially orthopedicians. Wound healing process can be at times complicated by infections resulting in prolonged hospitalization and even death. Negative pressure therapy was described in 1993 by Fleishmann *et al*, and was then introduced in clinical setting in 1997 by Argenta and Morykwas. It is currently a preferred method of wound management especially in infected wounds, diabetic foot ulcers etc due to its ability to reduce healing time, promotes wound healing, wound bed preparation for skin grafting, reduction of bacterial load and early development of granulation tissue by angiogenic stimulation etc. **Objective:** The aim of this study is to evaluate the outcome and benefits of negative pressure therapy (NPWT) in patients with infected wounds of lower limbs. **Methods:** After taking proper clearance from the hospital's ethical committee data records of 30 patients (mean age 49 yrs (18-80 yrs), 25 Males and 5 Females) treated at Govt. Medical College for infected wounds of lower limbs using negative pressure therapy during the time period of 1 year (1<sup>st</sup> September 2017 to 31<sup>st</sup> August 2018) were taken for analysis. This is a retrospective study and after analyzing the hospital records a final inference was made regarding final outcome and presented in suitable tabular and descriptive form. The negative pressure therapy (NPWT) was applied to the infected wound after proper Wound wash and debridement, in continuous mode for 5 days with a negative pressure between 50 to 200 mmHg. **Results:** As per our analysis the mean hospital stay was 30 days (20-40 days), mean intravenous antibiotic therapy was 10 days (5-15 days) and mean use of negative pressure therapy was 12.5 days (5- 20days). Use of negative pressure resulted in gross reduction in wound size and infection. Only 4 patients required a 2<sup>nd</sup> revised NPWT, 1 patient required 4 NPWT dressings but all the patients showed a positive outcome with respect to wound healing, complete eradication of infection. **Conclusion:** This analysis revealed that although the cost benefit ratio of using Negative pressure therapy for infected wound remains a debatable topic, still it has proven its worth by treating all the wounds and infections associated with them without causing the pain and discomfort to the patient which the patients with regular daily dressings experience.

Copyright © 2019, Sakib Arfee et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Citation:** Dr. Sakib Arfee, Dr. Abdul Ghani, Dr. Mudasir Rashid, Dr. Imran Yousuf Bhat, Dr. Omeshwar Singh and Dr. Mohammad Azhar Ud Din Darokhan, 2019. "Outcome of Negative Pressure Therapy in Treatment of Infected Wounds of Lower Limb. A Retrospective Study", *International Journal of Current Research*, 11, (01), 210-213

#### INTRODUCTION

Initially described by Fleishmann *et al* in 1993 with intention of improving wound healing, it was utilized in clinical setting in year 1997 by Argenta and Morykwas. It has now become an important tool in treating infected wounds without any complications so far.

**\*Corresponding author: Dr. Sakib Arfee,**  
Resident Orthopedics GMC Jammu, Govt. Medical College and Hospital Jammu, Jammu and Kashmir, India.

It works on the principle that when the wound bed is exposed to the negative atmospheric pressure (Continuous/intermittent) the fluid from the extracellular space is removed which then helps to reduce the infections and enhance the wound healing. The procedure of applying NPWT is based on certain principles. It consists of an open cell structured sponge which is cut to fit the size of wound adequately and is put inside the wound cavity. This sponge allows equal distribution of the negative pressure and also reduces the chances of high negative pressure which can lead to tissue damage.

Then this sponge is covered with transparent adhesive which creates a vacuum by avoiding any contact with external environment. This adhesive seal is cut at only one place through which the tube is placed and this tube is connected with the vacuum generating and collecting unit on the other side. NPWT works by two mechanism; *Microscopic* and *Macroscopic*. At Macroscopic level the collapse of pores of the sponge/foam transfers centripetal force to the wound causing wound shrinkage and decrease in potential dead space within the wound. Microscopically it causes alterations in hydrostatic and shear forces leading to changes in cell shape thereby promoting wound healing. It also reduces bacterial load of the wound and also helps in angiogenic stimulation.

## MATERIALS AND METHODS

A total of 30 patients were selected retrospectively from the hospital records of Govt. Medical College Jammu, who underwent treatment for infected wounds of lower limbs using Negative pressure wound therapy from 1<sup>st</sup> September 2017 to 31<sup>st</sup> August 2018. Among these patients there were 25 Males and 5 females. The above patients were selected by using following inclusion and exclusion criteria:

### Inclusion criteria

- All lower limb wounds irrespective of cause and location.
- Wound infection presence confirmed by positive culture reports.
- Negative pressure therapy used for treatment in addition to the wound wash/debridement and I/V antibiotics.
- Negative pressure applied for at least 5 days.

### Exclusion criteria

- Age <18 and >80 yrs.
- Who removed the NPWT dressing before completing 5 days post application.
- Patients with inadequate records and Follow-up.
- Patients with Peripheral vascular disease.

The main cause of these wounds was RTA followed by Diabetes followed by bed sores and idiopathic wounds (with inadequate history). In case of RTA patients 12 patients had implant in situ and remaining were cases of soft tissue injury. Intravenous antibiotic therapy was started even before application of NPWT and stopped by using blood investigations e.g. TLC, ESR, CRP Quantitative etc as guidelines. In patients who required more than 2 NPWT dressings antibiotics were stopped even before the last dressing when the blood parameters became normal. In 2012 Stannard *et al* in their study demonstrated 1.9 times increase in the risk of wound infections in patients not treated by NPWT. Fleischmann in his study of 313 infected cases treated with negative pressure, about 2/3<sup>rd</sup> of infected cases were closed generally without need of secondary suturing. In this study however 6% patients died and there were 4% recurrent infections. Muller *et al.*, in 1997 reported success in Negative pressure therapy application by treating 300 patients with infected wounds in Germany. Morykwas *et al.*, in 1997 in his experimental case series on animals, in order to check the effectiveness of NPWT in reducing bacterial load; he deliberately introduced large no. of microorganisms to punch

biopsy wounds and then applied NPWT to it. There was remarkable reduction in bacterial load after 4 days.

**Technique:** NPWT unit consists of a suction pump, suction pipe, a reservoir and a sponge/foam. The procedure of applying NPWT is based on certain principles. It consists of an open cell structured sponge which is cut to fit the size of wound adequately and is put inside the wound cavity. This sponge allows equal distribution of the negative pressure and also reduces the chances of high negative pressure which can lead to tissue damage. Then this sponge is covered with transparent adhesive which creates a vacuum by avoiding any contact with external environment. This adhesive seal is cut at only one place through which the tube is placed and this tube is connected with the vacuum generating and collecting unit on the other side. Mechanism of action has already been explained above. The dressing was applied after proper wound wash and debridement and removed after 5 days and not before that. The wound condition was examined and future course decided. In case of persistent infection another NPWT dressing was applied and the same process was repeated. However antibiotic therapy was independent of NPWT and was solely decided by Blood parameters. All the NPWT dressings were applied in Operation theatre under senior supervision.

## RESULTS

In this study the mean hospital stay was 30 days (20-40 days), mean intravenous antibiotic therapy was 10 days (5-15 days) and mean use of negative pressure therapy was 12.5 days (5-20days). Use of negative pressure resulted in gross reduction in wound size and infection.

**Table 1. Distribution of wounds acc To their anatomical locations**

S. NO	No. of Patients	Wound Site
1	8	Foot
2	4	Ankle
3	14	Leg
4	1	Knee
5	0	Thigh
6	2	Gluteal Region
7	1	Sacrum

**Table 2. Data regarding 30 patients showing cause, gender distribution and No. of NPWT dressings applied**

No. of Patients	Sex		Cause of Wound	No. of NPWT dressings
	M	F		
17	15	2	RTA	-
8	7	1	Diabetes	1 patient among these patients required 2 dressings
3	1	2	Paraplegia with Bedsore	1 patient among these patients required 4 dressings
2	2	-	Idiopathic	-

**Table 3. Wounds of lower limb which can b managed by NPWT.**

Bed sores
Burn wounds
Traumatic infected wounds(Acute/Chronic)
Flaps
Venous ulcers
Diabetic ulcers etc.

**Table 4. Contraindication of using NPWT**

Malignancy
Patients using anticoagulants
Fistulas
Untreated Osteomyelitis
Using NPWT directly on large vessels (e.g. Femoral Artery) etc.

Only 4 patients required a 2<sup>nd</sup> revised NPWT, 1 patient required 4 NPWT dressings but all the patients showed a positive outcome with respect to wound healing, complete eradication of infection, 4 patients further required flaps to cover the wound, 17 patients required PTSG and 9 patients required no further intervention. In our study we did not encounter any complications with the use of Negative pressure therapy. All the patients were benefited from the NPWT with eradication of infection in all cases. Except 1 patient all other patients were ready for final intervention or discharge after 10 days of NPWT application (Figure 1-4).



**Figure 1-2. Showing infected wound before and after serial debridements and NPWT application**



**Figure 3. Showing the wound in Fig 1&2 after PTSG**



**Figure 4. Showing Grade 4 Bed sore after multiple debridements and 4 NPWT dressings (Note: wound was grossly infected and Bone was exposed before application of NPWT dressing)**

## DISCUSSION

The use of NPWT in infected wounds of lower limb from this study has shown the promising effect regarding treatment outcome as all of the 30 selected cases were discharged from the hospital without any infection keeping in view the blood parameters and final wound condition. The use of NPWT is studied since last 15-20 years and its effectiveness is proven by several studies and clinical trails. NPWT not only helps in wound healing and infection eradication it also improves the quality of life of the patient by preventing further wound complications and also prevents from any future surgery in most of the cases. It gives the patients a sigh of relief from daily regular dressings and the pain associated with them hence has also a positive psychological impact.

There have been a lot of research and clinical trails which compare the regular conventional dressings with NPWT and almost all of these studies have shown superiority of NPWT over conventional dressings. NPWT has a very vast significance in wound management: Karatepe *et al.*, in 2011 published his randomized clinical trail showing benefits of NPWT regarding wound healing, quality of life etc in diabetic feet patients, as compared to regular conventional dressings. The results were greatly in favour of NPWT dressing. NPWT also reduces wound pain, and hence improving the patient compliance and experience along their wound treatment journey. The cost benefit ratio of using NPWT is still a topic of debate. Othman, in 2012 published a literature review regarding the cost effectiveness of NPWT, which shows enough evidence that NPWT is cost effective by cutting down the cost of chronic wound management especially infected wounds. Most of the patients which we are treating at GMC Jammu with NPWT complain only about 2 things regarding the use:

- Too costly.
- Confinement to their beds for all the time during the Treatment with NPWT (as most of these lower limb wound patients were mobile earlier with or without walking Aid).

Now a days portable and lightweight Negative pressure device are also available which allows the patients to roam around but these devices are not available in our setup currently.

## Conclusion

This study revealed that although the cost benefit ratio of using Negative pressure therapy for infected wound remains a debatable topic, still it has proven its worth by treating all the mentioned wounds of lower limb and infections associated with them without causing the pain and discomfort to the patient which the patients with regular daily dressings experience. All the patients responded positively and were happy with the results. By eradicating the infections and enhanced wound healing NPWT has made wound healing more comfortable and has improved the quality of life of these patients in addition to psychological upliftment. Certain studies have shown that intermittent therapy is yielding better results than continuous therapy.

## REFERENCES

- Borgquist O., Ingemansson R., Malmjö M. 2011. The Influence of Low and High Pressure Levels during Negative-Pressure Wound Therapy on Wound Contraction and Fluid Evacuation. *Plast Reconstr Surg* 127(2): 551-559.
- Center EE. 2009. BP-negative pressure wound therapy device. Technology assessment report. Prepared Agency Healthc Res Qual (AHRQ). Contract No. 290-2007-10063. Project ID: WNNT1108. Rockville, MD: AHRQ, March 30.
- Fleischmann W., Lang E., Russ M. 1997. (Treatment of infection by vacuum sealing). *Unfallchirurg*; 100(4): 301-304. <http://dx.doi.org/10.1007/s001130050123>.
- Hunter JE., Teot L., Horch R., Banwell PE. 2007. Evidence-based medicine: vacuum-assisted closure in wound care management. *Int Wound J.*, 4(3):256-69.
- Karatepe O., Eken I., Acet E. et al., 2011. Vacuum assisted closure improves the quality of life in patients with diabetic foot. *Acta Chir Belg.*, 111(5): 298-302.
- Leininger BE., Rasmussen TE., Smith DL., Jenkins DH., Coppola C. 2006. Experience with wound VAC and delayed primary closure of contaminated soft tissue injuries in Iraq. *J Trauma.*, 61(5):1207-11.
- McCallon SK., Knight CA., Valiulus JP., Cunningham MW., McCulloch JM., Farinas LP. 2000. Vacuum-assisted closure versus saline-moistened gauze in the healing of postoperative diabetic foot wounds. *Ostomy Wound Manag.* 46(8):28-32.
- Morykwas MJ., Argenta LC., Shelton-Brown EI., McGuirt W. 1997. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. *Ann Plast Surg.*, 38(6):553-62.
- Mouës CM., Vos MC., van den Bemd GJ., Stijnen T., Hovius SE. 2004. Bacterial load in relation to vacuum-assisted closure wound therapy: a prospective randomized trial. *Wound Repair Regen.* 12(1):11-7.
- Muller G. 1997. (Vacuum dressing in septic wound treatment). *Langenbecks Arch Chir Suppl Kongressbd* 114: 537-541.
- Mullner T., Mrkonjic L., Kwasny O., Vecsei V. 1997. The use of negative pressure to promote the healing of tissue defects: a clinical trial using the vacuum sealing technique. *Br J Plast Surg.*, 50(3): 194-199. [http://dx.doi.org/10.1016/S0007-1226\(97\)91369-2](http://dx.doi.org/10.1016/S0007-1226(97)91369-2).
- Orgill D., Manders E., Sumpio B., Lee R., Attinger C. et al. 2009. The mechanisms of action of vacuum assisted closure: More to learn. *Surgery* 146(1): 40-51.
- Othman D. 2012. Negative pressure wound therapy literature review of efficacy, cost effectiveness, and impact on patient's quality of life in chronic wound management and its implementation in the United Kingdom. *Plastic Surgery International.*, ( 12): 374398.
- Peinemann F., Sauerland S. 2011. Negative-pressure wound therapy: systematic review of randomized controlled trials. *Dtsch Arztebl Int.*, 108(22): 381-389.
- Scherer S., Pietramaggiori G., Mathews J., Orgill D. 2009. Short Periodic Applications of the Vacuum-Assisted Closure Device Cause an Extended Tissue Response in the Diabetic Mouse Model. *Plast Reconstr Surg.*, 124(5): 1458-1465.
- Scherer S., Pietramaggiori G., Mathews J., Prsa M., Huang S. et al. 2008. The Mechanism of Action of the Vacuum-Assisted Closure Device. *Plast Reconstr Surg.*, 122(3): 786-797.
- Scherer SS., Pietramaggiori G., Mathews JC., Prsa MJ., Huang S., Orgill DP. 2008. The mechanism of action of the vacuum-assisted closure device. *Plast Reconstr Surg.*, 122(3):786-97.
- Stannard J., Volgas D., McGwin G., Stewart R., Obrensky W., et al. 2012. Incisional Negative Pressure Wound Therapy After High-Risk Lower Extremity Fractures. *J Orthop Trauma.*, 26(1): 37-42.
- Strecker W., Fleischmann W. 2007. Nécroses cutanées traumatiques et non traumatiques. Pansements sous vide. *Appareil Locomoteur.* 2007:1-5, [http://dx.doi.org/10.1016/S0246-0521\(07\)43187-4](http://dx.doi.org/10.1016/S0246-0521(07)43187-4) (Article 15-068-A-10).
- Venturi ML., Attinger CE., Mesbahi AN., Hess CL., Graw KS. 2005. Mechanisms and clinical applications of the vacuum-assisted closure (VAC) Device: a review. *Am J Clin Dermatol*; 6(3): 185-194. <http://dx.doi.org/10.2165/00128071-200506030-00005>.
- Vikatmaa P., Juutilainen V., Kuukasjärvi P., Malmivaara A. 2008. Negative pressure wound therapy: a systematic review of effectiveness and safety. *Eur J Vasc Endovasc Surg.*, 36(4):438-48.
- Webb LX. 2002. New techniques in wound management: vacuum assisted wound closure. *J Am Acad Orthop Surg.*, Sep; 10(5): 303-311.
- Yang C., Chang D., Webb L. 2006. Vacuum-assisted closure for fasciotomy wounds following compartment syndrome of the leg. *J Surg Orthop Adv* 15(1): 19-23.

\*\*\*\*\*