

A Prospective Study to Evaluate the Effectiveness of Negative-pressure Wound Therapy for Management of Acute Traumatic and Chronic Wound in Orthopedics

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ABSTRACT

Introduction: Acute and chronic wounds affect at least 1% of the population. Regardless of etiology, wounds are difficult to treat. Modern wound healing concepts have convincingly been shown to give higher wound closure rates compared with traditional wet gauze dressings. **Objectives:** To evaluate the results and benefits obtained from the use of negative-pressure wound therapy (NPWT) in patients with acute and chronic wounds in orthopedics. **Material and methods:** This was a prospective study of 26 patients (16 males and 10 females, mean age 41.76 years) with acute and chronic wounds treated using NPWT. The acute wounds were caused by trauma (road traffic accident [RTA], fall from height, crush injury). The chronic wounds stated in this study were from pressure sores in paraplegic patients. The treatment system used was VAC (vacuum-assisted closure, KCI, San Antonio, United States), applied to the wound in continuous mode from 100 to 125 mmHg. **Results:** The mean length of the use of NPWT was 20 days. The use of VAC led to a mean reduction of 37% in the wound area (157.12-120.57 cm²; $p < 0.05$). Exposed tendons and bone were successfully covered with healthy granulation tissue in all cases. In all patients, coverage with granulation tissue was achieved and followed by a skin graft. No major complication occurred that was directly attributable to the treatment. **Conclusion:** NPWT eases the process of wound healing by formation of local infection free healing tissue in a short period of time and reduces hospital stay and morbidity.

Keywords: Negative-pressure wound therapy, wound healing, wounds and injuries, pressure sore

Dealing with wound is a matter of knowledge and experience. Different etiologies such as trauma and infection may lead to acute and chronic wounds. Regardless of etiology, wounds are difficult to treat if co-existing factors (e.g., infection or diabetes mellitus) prevent regular wound healing. Wounds represent a significant risk factor for hospitalization, amputation, sepsis and even death, and from the patient's perspective, wound therapy is often uncomfortable or painful. Modern wound healing concepts include different types of moist dressings and topical agents, although only a few of these treatments have convincingly been shown to give higher wound closure rates compared with traditional wet gauze

dressings. Negative-pressure wound therapy (NPWT) is a newer noninvasive adjunctive therapy system that uses controlled negative-pressure, using vacuum-assisted closure (VAC) device, to help promote wound healing by removing fluid from open wounds, preparing the wound bed for closure, reducing edema and promoting formation and perfusion of granulation tissue.

Negative-pressure wound therapy, also known as VAC dressing, provides the following benefits: control of drainage of fluids, reduction of local edema, reduction of bacterial load and early development of granulation tissue by angiogenic stimulation. The aim of the present study is to evaluate the effect of NPWT in management of acute and chronic wounds in the orthopedic set-up.

MATERIAL AND METHODS

The present study was undertaken at ESI Hospital, Basai Darapur, New Delhi, India. Over a 1 year period, from July 2017 to July 2018, 26 patients (16 males and 10 females; Table 1) with acute and chronic wounds were treated with NPWT device (VAC, KCI, San Antonio, United States).

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Table 1. Patients Demographic Data

Sex	Number	Percentage (%)
Male	16	61.53
Female	10	38.46

The following inclusion criteria were adopted: Presence of positive culture, use of vacuum drainage for over 5 days, purulent local drainage and tissue necrosis.

Patient exclusion criteria included: Small-sized acute wounds with no comorbid conditions, age less than 15 years, mental disorders, systemic sepsis, malignancy and osteomyelitis.

All 26 patients were followed for minimum 6 months (mean 11 months, range: 6-18 months). Mean patient age was 41.76 years (range: 16-67 years). In all acute wounds, VAC was used when granulation tissue started to appear. In regard to chronic wounds, the lesion was debrided to refresh the bed and the edges before application of VAC. On average, wound was assessed every 4th day in term of the size, the defect and evolution of state of the wound. Final procedure after VAC therapy and complications related to the use of this therapy were evaluated. Patients were followed-up regularly in the OPD with minimum follow-up period of 6 months.

RESULTS

In the present study, 26 patients (16 males and 10 females) with mean age 41.76 years (16-67 years) were included. Out of the 26 patients, 20 patients had acute post-traumatic wound and 6 patients were having chronic wound. All patients were given a mean of 12 days of intravenous antibiotic therapy (8-42 days). The median duration of VAC therapy was 20 days (5-50); on average, the dressing was changed every 4th day.

A 37% mean reduction of wound area was observed, from 157.12 cm² to 120.57 cm² after VAC application. In all patients, coverage with granulation tissue was achieved and followed by a skin graft. Table 2 summarizes the results of VAC therapy.

Almost all patients achieved an improvement in the final appearance of the wound site, with infection eradication. No complications that could be directly attributed to the use of NPWT, such as deep bleeding or worsening local infection, were observed. Three patients had mild local itching, which was successfully treated with oral medication, allowing for the maintenance of treatment.

Table 2. Results of VAC Therapy

Age	Area before VAC	Area after VAC	Days	VAC exchange	Procedure
16	25	18	10	3	Skin grafting
46	300	220	46	12	Skin grafting
25	12	5	12	3	Skin grafting
46	170	128	30	7	Skin grafting
36	89	76	36	10	Skin grafting
30	65	44	16	4	Skin grafting
32	68	49	16	4	Skin grafting
49	100	70	25	6	Skin grafting
53	129	119	20	5	Skin grafting
39	96	50	25	6	Skin grafting
58	10	7	22	5	Skin grafting
67	46	40	20	6	Skin grafting
39	280	130	25	4	Skin grafting
25	320	260	16	5	Skin grafting
32	26	22	20	5	Skin grafting
29	10	6	5	2	Skin grafting
60	128	96	30	5	Skin grafting
35	125	94	26	5	Skin grafting
62	430	310	50	12	Skin grafting
59	16	12	16	4	Skin grafting
39	280	264	18	5	Skin grafting
43	87	55	19	5	Skin grafting
49	432	380	30	6	Skin grafting
46	360	260	18	5	Skin grafting
39	320	255	18	5	Skin grafting
35	160	120	16	4	Skin grafting



Figure 1. Wound before VAC.

Figures 1-3 depict the wound before VAC, after VAC and after skin grafting, respectively. Figures 4 and 5 also depict a wound before and after VAC.

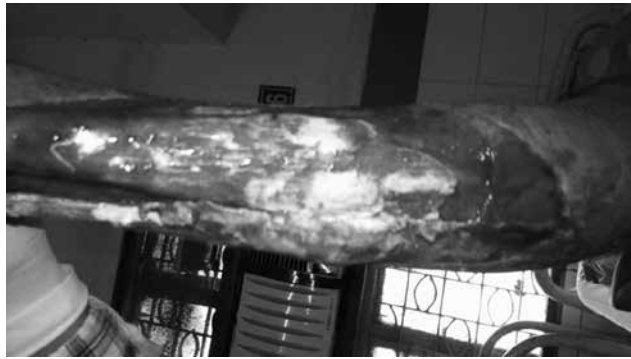


Figure 2. Wound after VAC.



Figure 3. Wound after skin grafting.

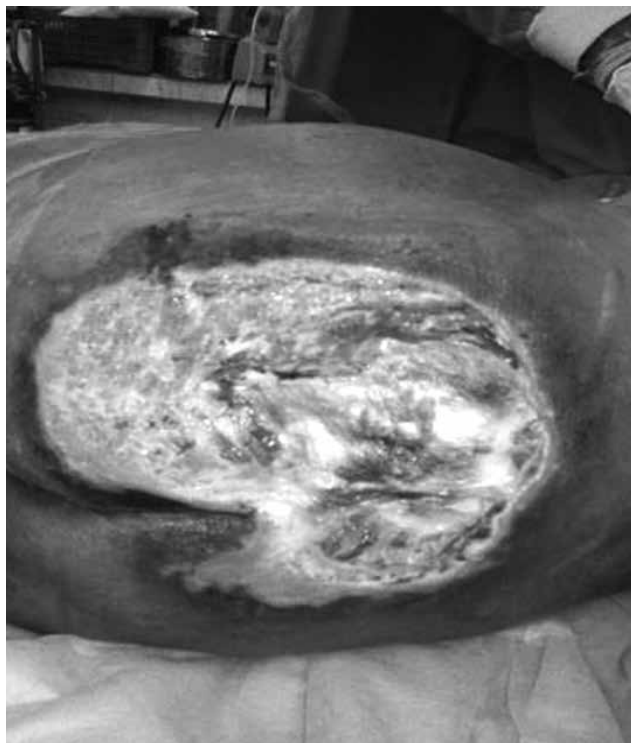


Figure 4. Wound before VAC.



Figure 5. Wound after VAC.

DISCUSSION

Numerous papers have been published on VAC therapy, which suggest that the technique may have an important role to play in the management of chronic or infected wound. The topical use of NPWT has been widely studied in the literature over the past 20 years. A vast majority of clinical trials has shown the effectiveness of this therapy in the treatment of superficial wounds. The localized use of NPWT in infected wounds offers advantages such as wound drainage, angiogenesis stimulation, proteinase excretion and decreased local and systemic bacterial load.

In the present study, the mean time of VAC use was 20 days and the mean duration of intravenous antibiotic therapy was 12 days, in contrast with data in the literature indicating the use of intravenous antibiotics for 6 weeks for patients with infected wounds. In this treatment period, the dressing was changed every 4th day, providing comfort to the patient and the nursing staff, while maintaining a clean dressing without the need for daily changes.

In the present study, healthy infection-free granulation tissue was obtained in all patients, alongside a significant decrease in lesion size. These data are similar to those obtained by Gregor et al, who, in a systematic review to assess the effectiveness and safety of VAC compared to conventional therapies for complex wounds, observed a significant reduction of the lesion area for those treated with VAC, without significant adverse effects. In the present study, there were no major complications, such as hemorrhage, etc.

CONCLUSION

NPWT therapy adheres to DeBakey's principles of being short, safe and simple. The VAC system eases the process of wound healing in chronic and acute wounds with reduction in morbidity and hospital stay. NPWT facilitates the formation of a local infection-free healing tissue in a short period of time, which reduces the need for complex surgical procedures for the final coverage of important structures. From this present study, it is concluded that NPWT is a safe, effective and fast alternative to conventional dressing in the treatment of acute and chronic wounds. There is no significant complication associated with the use of NPWT. The main limitation of the present study, apart from the small sample size, was the lack of a control group, which did not allow for a direct comparison of patients treated in the same center with conventional method or NPWT. Future studies with large sample size and control group are needed to accurately assess the benefit of VAC therapy.

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**More Children Killed by Unsafe Water, Than Bullets**

A lack of safe water is far deadlier for children than war in more than a dozen conflict-affected countries, the UN Children's Fund (UNICEF) said recently, in a report launched to coincide with World Water Day, marked on 22 March. UNICEF's 16-nation study into how water supplies effect children caught up in emergencies, also shows that children under-five are on average more than 20 times more likely to die from illnesses linked to unsafe water and bad sanitation, than from conflict.

"The odds are already stacked against children living through prolonged conflicts - with many unable to reach a safe water source," said UNICEF Executive Director Henrietta Fore. "The reality is that there are more children who die from lack of access to safe water than by bullets."

According to the report, every year, 85,700 children under-15 die from diarrhea linked to unsafe water, sanitation and hygiene facilities (WASH), compared with 30,900 from conflict. Some 72,000 under-fives die annually from similar illnesses linked to WASH-access problems, compared to 3,400 from war-related violence. UNICEF studied data from Afghanistan, Burkina Faso, Cameroon, the Central African Republic, Chad, the Democratic Republic of the Congo, Ethiopia, Iraq, Libya, Mali, Myanmar, Somalia, South Sudan, Sudan, Syria and Yemen... (UN)