



Results of VAC (Vacuum Assisted Closure) therapy in the treatment of compound fractures of long bones

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Abstract

Introduction: *Type of study-prospective study.*

A high bacterial load interferes with the healing process of a wound. Vacuum-assisted closure (VAC) is a therapy that helps in wound healing and utilizes a dressing system that continuously or intermittently applies a negative pressure to the wound surface.

This study was done to note the results of VAC (Vacuum Assisted Closure) dressing in wound healing, and also to note the complications that occur in VAC Dressings cases.

Here we compared the VAC dressings and conventional moist wound dressings to enhance the wound healing process and to establish that VAC dressings are better option in the management of wounds.

Material and Methods: *This study was done in 30 patients*

Time period of study- approximately 2 years from November 2020 to October 2022.

Place of study- Rajendra Institute of Medical Sciences, Ranchi.

Material used for the applying of VAC dressings are:

A) Redon drainage tubes with suction

B) Cuticell -paraffin gauge

C) a sponge foam

Results: *Majority of the cases showed better wound healing in 12-14 days while 18.33% of the cases who were above 60 years of age, showed healing by the end of 3-4 weeks. Although a sample size of 30 patients is sufficient for data analysis, a randomized controlled study with a larger population may help to further establish the findings or show variations.*

Conclusion: *VAC therapy can be used effectively after wound debridement, because it promotes the formation of granulation tissue, reduces wound oedema, and decreases microbial growth.*

Keyword: *VAC dressings, moist wound dressing, negative pressure dressing, wound healing.*

Introduction

This study was done to assess the efficacy of topical negative pressure wound dressings as compared to conventional moist wound dressings in improving the healing process and to prove that negative pressure dressings can be used as a much

better treatment option in the management of wounds. It is used as an adjunct or alternate to surgery for wide range of wounds with an aim to decrease morbidity, cost, duration of hospitalization and increase patient comfort.

While VAC supposedly removes bacteria from the treated wounds and therefore reduces the risk of infection, this relationship has not yet been clinically proven.

Process of healing is mentioned thousands of years ago. Earlier the science of wound healing was mixed with superstitions. Bacteriology was developed as a branch of medicine by work of *Louis Pasteur*. His studies encouraged *Joseph Lister* to research on wound sepsis. He succeeded in 1867 which increased scope of surgery which was limited by fear of sepsis. Today even with huge advances in medical sciences, wound management still remains a challenge. Wounds can affect patient's quality of life, causing financial, social, and psychological disturbances. Some wounds don't heal or suffer from delayed healing in spite of various management methods. The practice that wounds should be kept dry, although still held by a considerable number of clinicians, is steadily losing ground. We have calculated that wounds develop granulation tissue faster when treated with moist wound dressings. Airsealed packing of the wounds does not lead to infection. Many techniques have been developed and tried over the centuries to heal wound. Although wound dressing have been used for a long era, there exists no ideal dressing. Dressing of wounds is based on the surgeon's choice and training. During the last two decades a wide variety of innovative dressings have been introduced. Wound management presents a huge burden on health systems. Negative pressure wound therapy, provides the advanced management of various wound types. Recent studies have shown that maintaining a negative pressure in a controlled manner to the wound site helps in wound healing. *Argenta LC et al* presented the original description of Negative Pressure Wound Therapy. The concept is based on Physics. VAC can be adjunctive therapy pre or post operatively. Alternative names for VAC include NPWT, topical negative pressure, sub-atmospheric pressure, sealed surface wound suction, vacuum sealing and foam suction

dressing. The compression of tissue by negative pressure causes tissue hypoxia due to decreases perfusion beneath the foam which stimulates angiogenesis, and local vasodilatation due to release of nitric oxide. This occurs during the "suction off" periods of VAC therapy. Therefore intermittent mode of VAC is more effective as compared to continuous mode.

Material and Methods

This is a prospective randomized study, including 30 patients with traumatic compound fractures, done at Rajendra Institute of Medical Sciences, Ranchi, Jharkhand between November 2020 and October 2022. This study was done in patients who gave consent. This study was done as a prospective randomised controlled study to find out outcome of the efficacy of VAC to conventional moist wound dressing in management of wounds. The application of VAC dressings needs the following materials: Cuticell (paraffin impregnated gauze), a sponge foam/ Cutisorb (sterilised dressing pad), a pair of Redon drainage tubes with suction in wards.

Method of Application: Method of VAC application includes thorough debridement, wash adequately with saline, adequate haemostasis and application of sterile foams dressing. A fenestrated tube is embedded in the foam and wound is sealed with adhesive tape to make it air tight. The fenestrate tube is connected to a vacuum pump with fluid collection container. The machine delivers continuous or intermittent negative pressure, ranging from 50 to 125 mmHg. The VAC dressings are changed on 3rd day. The position of tubing is away from bony prominences. Intermittent mode consists of a cycle of 5 min on and 2 min off phase. The pressure setting can be kept low (50–75 mmHg) particularly for painful chronic wounds. Higher pressures (150 mmHg plus) are used for large cavity and exudative wounds.

Negative pressure of 125 mm Hg is considered as an optimal pressure. Effects of different levels of negative pressure (10–175 mmHg) in different

wounds showed that the level of negative pressure should be tailored according to the wound types. Acute traumatic wounds requires negative pressure of 125 mm Hg and for chronic non healing venous ulcer the optimum pressure is 50 mm Hg at intermittent cycles.

Duration of Study: 2 years from November 2020 to October 2022.

Sample size: 30 cases.

Inclusion Criteria

1. Wounds caused by trauma, with soft tissue injury.
2. Post- op and dehisced surgical wounds with exposed bone,
3. Fasciotomy wounds in compartment syndrome.

Exclusion Criteria

1. Non co-operative patients.
2. Patients with malignancy, bleeding disorders, on anti-coagulants.
3. Wounds with exposed vessels, nerve and tendon.
4. Those who were not willing were subjected dressing.

Results

The 30 patients admitted for the study which was subjected to VAC therapy.

Age and Gender Distribution

Age/gender	No. of patients	Percentage
15-24 years	1	3.33
25-34 years	5	16.67
35-44 years	6	20
45-54 years	6	20
55-64 years	7	23.33
65-74 years	3	10
75-85 years	2	6.67
Male	18	60
Female	12	40
Total	30	100

Basic Patient Data

No. of patients	30
Range of age in years	20-80
Male-female ratio	18:12
Wound surface area(cm ²)	5-180

Day wise progress in wound

Wound floor		21-40	41-60	
Day 7	8	15	6	1
Day 14	2	7	11	9
Day 21	1	2	6	10
Day 28	0	0	2	6

Microorganisms Seen

Microorganisms	No. of patients	Percentage
Staph	13	43.33
E coli	5	16.66
Others	3	10
No growth	9	30
Total	30	100

Treatment done

Treatment done	No. of patients	Percent
Secondary suturing	6	20
Secondary healing	3	10
Split thickness skin grafting	21	70
Total	30	100

Most patients had no complications during the treatment period. Except around 10% patients had minor complications like pain during the application of VAC, or during removal of the dressing; some had bleeding. One patient on VAC had necrosis of the surrounding skin which may be caused either due to wound desiccation , or due to pressure point.

Discussion

It can be used in the management of both acute and chronic wounds, and complex wounds such as burn wounds. VAC stimulates wound healing through two processes called macrostrain and microstrain. Macrostrain draws the edges of the wound together, equally distributes the negative pressure, and removes exudate and infectious materials. Microstrain reduces edema, stimulates perfusion, and stimulates granulation tissue formation.

The vacuum-assisted closure is a non-pharmacologic/non surgical means for modulating wound healing; it was first proposed by Argenta and Morykwes in 1997.

Accidents due to various causes like road traffic accidents etc cause polytrauma resulting in

compound fractures and such patients were studied. This study includes patient's age ranging from 20 to 80 years, common being 30 to 65 years, and mostly in patients more prone to accidents like labourers, drivers, etc. The sex ratio in males to females is 1.5:1, showing male dominance due to male exposure to more stressful situations. The total hospital stays for the patients showed a mean period of 32.5 days which is significantly less than the standard other modalities followed in normal practice. Wound dressings have gradually evolved from merely providing physical protection to the exposed surface; absorbing exudates and controlling local infections by local applications of medications; to giving adequate environment which promotes wound healing. This has been achieved by modern wound dressing techniques by promoting granulation tissue formation. The concept of moist wound dressings which came into practice in the decade of 60s which revolutionized wound care. This led to further research in this direction leading to influx of many products like semi permeable plastic film dressings, hydrocolloids, hydro gels, collagen dressings into the wound care scenario, each claiming a better wound healing rate than the others. Study conducted by M. Singh *et al.* reported good results with manually operated vacuum devices. Marcus *et al.* presented a prospective study of randomizing 22 patients. Two groups of 11 patients each with pressure sores in the pelvic region were included. The time difference to heal was almost the same in the group treated with VAC (27 days) and the traditional group with Ringer's solution dressings thrice a day (28 days). However, no hospital stay, reduced costs, and improved comfort were noted in the VAC group. Baynham *et al.* found that three-stage sacral and ischial wounds, which were resistant to surgical therapy for the past 10 months, got healed in about 2 months with VAC. The device operated at negative pressure of 125 mmHg with 5 min on and 2 min off cycle. As the concept of "outcome based medicine" evolved, the need for a better wound dressing modality

became more acute. Now wound dressing systems were compared not only on the basis of the rate of granulation tissue formed, or the rate of wound healing, but also on the cost and duration of hospital stay of the patient which was considered as a measure of the morbidity of the patient. Vacuum therapy is contraindicated in patients with malignant wound, osteomyelitis, fistulae to organs or body cavities, presence of necrotic tissue and those with exposed arteries/nerves/anastomotic site/organs. Relative contraindications include patients on anticoagulants or with actively bleeding wounds. Povidone-iodine is a polyvinylpyrrolidone and elemental iodine complex. Iodine has been effectively used as a broad-spectrum antimicrobial agent for more than 170 years. However, its use has been limited due to its cytotoxicity. Iodine dressings involve the slow release of iodine into the wounds. These dressings are only for a relatively short period and require frequent changes. Previous studies have reported that long-term use of povidone iodine is associated with mild hyperthyroidism, therefore medical supervision in patients with thyroid disease or iodine sensitivity is required. Research suggests that negative pressure causes an increase in vascular diameter, volume, and velocity of the blood flow. The mechanism of VAC therapy is not thoroughly clear; however, evidence put forward that interstitial pressure gets decreased due to edema reduction, which positively influences lymphatic drainage, oxygen, and also the nutrient availability. By providing a moist environment, VAC therapy promotes formation and development of the blood vessels (angiogenesis), tissue granulation, and stimulates cell proliferation by causing mechanical stress in the wound bed. The treatment should be continued until healthy granulation has formed over the surface of the ulcer.

Conclusion

In the past two decades, several studies have been performed to find out the relationship between

VAC and changes in the wounds' microbiology. Various reviews have provided an overview of the overall effectiveness of VAC and recommendations for use.

VAC therapy may be used as first dressing after the debridement of wound, because it decreases wound oedema and enhances the formation of granulation tissue. Thus by increased rate of development of granulation tissue, the VAC decreases the size of the wound 3 dimensionally . This wound is easily healed by secondary intention, or can be managed with a simple skin graft or flap. Without the VAC, this wound might have required to be treated with a pedicle or microsurgical free flap. Results of grafts are also better in cases of VAC therapy. Duration of hospital stay was reduced in the VAC therapy group. VAC therapy was safer way of dressing with better patient compliance. VAC however is technically more demanding.

Complications of VAC therapy include failure of the VAC system (loss of seal, power failure, and blockage of the drainage system), wound infection, pain, bleeding, allergies to the adhesive drape, excoriation of the skin, restricted mobility, adherence of the tissues to the foam, lack of patient compliance and skin necrosis. Air leak in the dressing should be avoided as it leads to continual flow of air over the wound surface leading to desiccation of tissue and formation of eschar. This eschar seals the wound with retained exudate and leads to worsening of the wound. The pressure in VAC dressing gradually reduces over 2 days therefore, dressings should be changed after 48 h. One word of caution the VAC therapy should not be terminated abruptly after one session as it may result in a rebound phenomenon and worsening of the wound. Therefore 2–3 sessions of VAC should always be planned.

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