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Original Research Article

Comparative study of vacuum-assisted closure therapy versus vacuum-assisted closure therapy supplemented with vitamin C in compound wound healing

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ABSTRACT

Background: It is imperative for early and precise management of the compound wound for preventing further complication and delaying definitive management. As we all know superiority of vacuum assisted closure (VAC) therapy in wound management over any other method, but adding vitamin C has been shown to accelerate wound healing, reducing hospital stay, and cost of management and prevention of delaying definitive management of wound due to some conspicuous property of vitamin C that serve as superior adjuvant in wound healing.
Methods: A case series of 40 patients who have been inflicted with compound wounds with most following road traffic accidents. We then categorised patients and tried to observe any difference in rate of satisfactorily healing of wound with 20 patients put on VAC therapy alone and other 20 patients put on VAC therapy supplemented with vit C.
Results: Patients who were undergoing VAC dressing and supplemented with vitamin C, not only portrayed a better result of wound healing but also reduced the amount of vacuum dressing sittings.
Conclusions: It was observed that, in general, patients who were undergoing VAC dressing and supplemented with vitamin C, not only portrayed a better result of wound healing but also reduced amount of vacuum dressing sittings, improved rate of granulation tissue, reduced hospital stay, early definitive fixation of associated fracture and skin grafting and showed superior outcomes in terms of better tissue recovery.

Keywords: VAC therapy, Vitamin C, Wound healing

INTRODUCTION

Since its introduction in clinical practice in the early 1990's negative pressure wounds therapy (NPWT) has become widely used in the management of complex wounds in both inpatient and outpatient care. Increasingly, NPWT is being applied in the primary and home-care setting, where it is described as having the potential to improve the efficacy of wound management and help reduce the reliance on hospital-based care.[1] Compound injuries of the limbs often demands meticulous care to prevent complications like infection, delayed healing, and delayed time required for definitive fixation of fracture associated with wound. It has always been a challenge to surgeon to bring about early functional limb following compound injuries associated with fractures.[2]

Challenges are wound contamination, extensive soft tissue damage, stabilisation of associated fracture, inadequate soft tissue coverage. VAC therapy has been the answer to these challenges after meticulous debridement and stabilization of limb inflicted with compound injuries.[3] We are very well versed with efficacy of VAC therapy while dealing with these complicated compound injuries, but using supplementary vit C as adjunct therapy has shown some promising results.

So, our aim is to observe, compare and study role of vit C along with VAC therapy while treating compound injuries and VAC therapy alone.[4]

METHODS

This comparative study was conducted on 40 patients in the department of orthopaedics, Dr. D. Y. Patil medical school and research institute, Navi Mumbai over a period of 6 months after obtaining permission from institutional ethical committee and talking informed and written consent from the patients. Microsoft excel was used as the platform to statistically analyse the data.

All patients above 18 years of age with compound injuries in extremities that required coverage procedure were included in the study. However, patients with pre-existing osteomyelitis in the wound, neurovascular deficit in the injured limb, malignancy, diabetes mellitus and peripheral vascular disease were excluded from the study. The patients were prospectively randomized into one of the two treatment groups receiving either the VAC therapy alone or supplemented with oral vitamin C in addition to VAC therapy.

Morykwas and colleagues postulated that multiple mechanisms might be responsible for the beneficial results obtained from VAC. They suggested that removal of interstitial fluid decreases localized oedema and increases blood flow, which in turn decreases tissue bacterial levels. All 40 patients who had compound injuries following road traffic accidents, were treated in accordance with ATLS guidelines in the emergency room. Initial decontamination of the wound was done after giving wash with normal saline and betadine solution. Limb was immobilised and stabilised with well-padded slab immobilising one joint above and one joint below the wound. Out of 40 patients, 18 patients had an associated fracture in the lower limb while the remaining had extensive soft tissue damage with no skin coverage. So, 20 patients were given VAC therapy after initial debridement and stabilisation of limb and put on 500 mg of oral vit C on admission and continue two times daily dose for first week and then once a day for 6 weeks. These doses are framed in order to prevent serious consequences of vitamin C overload and kidney stones. Other 20 patients were treated with standard management of compound injury and later VAC therapy alone. All patients were taken to emergency OT for meticulous wound debridement and inspection for vascular and nerve injuries. No patient had vascular and nerve injuries.18 patients who had associated fracture were given stabilisation with external fixation. Only 4 patients were given VAC therapy on day 1 while rest on an average day 2. After an interval of 7 days, VAC dressing has been changed and checked for need of debridement if any. Number of VAC dressing given depends upon the rate of appearance of granulation tissue. Split skin grafting required in 24 patients. All patients followed for a period of 6 months. The VAC treatment applies localized negative pressure applied to a special dressing positioned within the wound cavity or over a flap or graft that assists with the removal of interstitial fluid thereby decreasing localized edema and increasing the blood flow. Thus, decreasing the tissue bacterial levels. The technique has yielded good results in the studies reported, and also this technique is comparatively cost effective as compared to the conventional treatments, particularly in wounds that are difficult to heal.

RESULTS

Out of the 40 patients in which the study was conducted, 20 had a history of chronic smoking and alcoholism. Impressive granulation tissue development was found in patients with chronic smoker and alcoholics who were supplemented with vitamin C. These patients had early return to normal activities of life as compared to those who had been treated with VAC therapy alone.

Thus, we can satisfactorily make a note that vacuum dressing studies aided with vitamin C proved to be better conduit in terms of faster wound healing, rapid recovery, along with minimal duration of stays in the hospital during COVID pandemic thereby reducing hospital cost and inadvertent contact with COVID patients.

Table 1: VAC data.

Variables	No. of VAC sittings	Time taken for appearance of granulation tissue	No. of days of hospital stay	Time taken for definitive fixation of associated fracture and skin graft	Rate of wound contraction	Time interval between injury and presentation
VAC dressing alone (20 patients)	07	14 days	7 weeks	7 weeks	4 weeks	Less than 24 hours
VAC dressing with vitamin C supplementation (20 patients)	04	08 days	4 weeks	4 weeks	3 weeks	24 to 48 hours

In case number one wound with rich granulation tissue and healthy wound margin following treatment with vacuum assisted closure therapy supplemented with vitamin c after three weeks.

Table 2: Decrease wound size from day 1 to day 14.

Measurement (mm)	VAC therapy alone (N)	VAC therapy supplemented with vit C (N)
1-4.9	4	8
5-9.9	4	6
10-14.9	3	5
15-19.9	2	2
20-24.9	2	3
>25	1	0

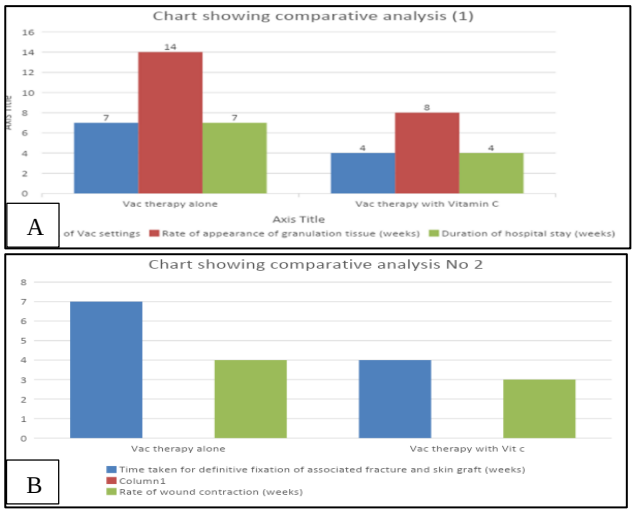

Figure 1 (A and B): Comparative analysis between VAC therapy and vit C accompanied VAC therapy in relation to rate of appearance of granulation tissue and duration of hospital stay. Comparative analysis between VAC therapy and vit C accompanied VAC therapy in relation to time for definitive fixation of associated fracture and skin graft and rate of wound contraction.

Figure 2 (A and B): A 45 year female with compound wound injury after accidental fall status on admission and later debridement done.

Figure 3 (A and B): Complete compound wound healing following VAC therapy supplemented with vitamin C after 8 weeks of treatment.

Figure 4 (A and B): A 32 year old male patient with RTA presented with contaminated compound wound on admission and debridement procedure.

Figure 5 (A and B): RTA presented with contaminated compound wound. Wound status 3 weeks post vac therapy with vit C, wound status 6 weeks post vac therapy with vit C.

DISCUSSION

While observing patients with compound wound over a period of time treated with VAC therapy alone and VAC therapy supplemented with vit C, we have pointed out some promising results in terms of accelerated wound healing, minimizing infection rate, early appearance of granulation tissue, decrease drain output, decreased hospital stay and minimizing the cost of treatment.[6] Vitamin C which is also known as ascorbic acid play vital role in all phases of wound healing. Neutrophil apoptosis and clearance are brought.[7]

With vit C synthesis, maturation, secretion and degradation of collagen is possible. Being an antioxidant, it leads to protection from oxidative stress and brings about early angiogenesis and improved tensile strength in wound area.[8] Deficiencies affect the maturation phase by altering collagen production and scar formation. The body strives to maintain homeostasis of AA, thereby ensuring availability for collagen synthesis. After wounding, plasma and tissue levels of AA diminish and, as a consequence, supplements may be useful for healing, although levels beyond saturation are excreted.[9] Clinicians need to be aware of both the nutritional status of patients with either acute or chronic wounds and the possibility of any AA deficiency which may hinder healing. We take a look at comparative clinical efficacy of compound wound treat with VAC alone vs. VAC therapy supplemented with vit C.[10] The last step in the proliferation phase is the development of the acute granulation tissue. At the same time the remodelling phase is already initiated.[11] As a transitional tissue it replaces the fibrin-/fibronectin-based provisional wound matrix and might produce a scar by maturation.[1,3,4,7,8,14,33] Furthermore, it is characterized by a high density of fibroblasts, granulocytes, macrophages, capillaries and loosely organized collagen bundles.[12]

Limitations

Limitation are non-compliant patients, patients refusing to take vitamin C as a supplement, absence of a trained personnel, loss of sterility while application, inability of the patient to accept the fact that VAC can be helpful, failure to maintain loss of hygiene by the patient and loss of follow up.

CONCLUSION

It was observed that, in general, patients who were undergoing VAC dressing and supplemented with vitamin C, not only portrayed a better result of wound healing but also reduced amount of vacuum dressing sittings, improved rate of granulation tissue, reduced hospital stay, early definitive fixation of associated fracture and skin grafting and showed superior outcomes in terms of better tissue recovery. Wounds associated with fractures also had finer outcomes and required shorter stays in hospital, thus making it less prone for acquiring COVID-19 infection during the pandemic.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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