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Vacuum assisted closure therapy versus standard wound therapy for compound fractures

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Abstract

Introduction: Compound fractures are surgical emergencies which require both skeletal stability as well as adequate soft tissue coverage. Debridement of all the dead and necrotic tissue can result to large soft tissue defects. Vacuum assisted closure therapy is a newer modality which can overcome all these problems and accelerates wound healing when applied to open wounds.

Aim and Objectives: To analyse and compare the results of vacuum assisted closure therapy and standard wound therapy in management of compound fractures.

Materials and Methods: 30 patients having compound fractures upto grade IIIB (Gustilo and Anderson classification) were randomly treated either using SWT or VAC therapy between November 2014 to June 2016. There were 15 patients in each group. After initial wound debridement and provisional fracture fixation, therapy was started and continued till the wound got optimized for coverage either by split skin graft or flap.

Results: The mean time taken by wound to get optimized for coverage in the VAC therapy group was 10.13 ± 2.55 days whereas in SWT group was 11.20±1.65 days. The mean rate of decrease in size of wound by VAC therapy was 1.5453 ± 0.5855% whereas by SWT was 1.0587 ± 0.3637%. Infection was seen in 02 patients in the VAC group and in 05 patients in the SWT group.

Conclusion: VAC therapy is superior to SWT in terms of rate of decrease in size of wound, lesser infection rate and shorter time for wound to get optimized for coverage.

Keywords: Compound Fracture, VAC (Vacuum assisted closure), SWT (Standard wound therapy), Flap, Split Skin Graft.

Introduction

Compound fractures are surgical emergencies which require both skeletal stability as well as adequate soft tissue coverage. Debridement of all the dead and necrotic tissue can result in large soft tissue defects precluding healing through delayed primary closures or secondary intention.[(1)]

Various surgical methods have been developed to obtain coverage in these difficult situations like skin grafts, myocutaneous or fasciocutaneous flaps but even skin grafts are contraindicated when bone is exposed.[(2)] In such situations, a local rotation flap may be required to obtain coverage.[(3,4)]

Vacuum assisted closure (VAC) therapy is a newer technique designed to promote granulation tissue formation for faster healing in the wounds resulting from compound fractures.

Materials and Methods

30 patients attending OPD and Emergency Department of Orthopaedics, SRMS-IMS, Bareilly were randomly treated either using SWT or VAC therapy between November 2014 to June 2016.

Two treatment groups with 15 patients in each group were made and patients were prospectively randomized into one of the two treatment group. Group I consisted VAC therapy patients and group II consisted of SWT patients.

Inclusion Criteria included patients with Type IIIA, IIIB fractures (Gustilo and Anderson classification), late presentation of Type II fractures, traumatic amputations resulting from compound fractures, post-operative infective wounds in compound fractures and delayed wound management in polytrauma cases. Exclusion criteria included patients with exposed vessels in the wound and patients having wounds due to diabetes, osteomyelitis, malignancies and peripheral vascular disease.

Standard wound Therapy Procedure: After removing initial dressing from the wound, culture swab was immediately taken prior to debridement. Then all the necrotic tissues were debrided and wound was thoroughly irrigated with normal saline and measured using Vernier calliper.

Daily dressings were done by conventional methods that is with saline soaked gauzes.

Depending upon the amount of slough present on each dressing, serial debridements were done under local anaesthesia prior to application of next standard wound dressing.

Vacuum Assisted Closure Therapy Procedure: After removing initial dressing from the wound, culture swab was immediately taken prior to debridement. Then all the necrotic tissues were debrided and wound was thoroughly irrigated with normal saline and measured using Vernier calliper. Then skin around the wound was thoroughly dried and sterile, open-pore polyurethane

foam having 400 – 600 microns size cut according to shape and size of wound was placed into wound cavity. Foam was then sealed with an adhesive drape. A small opening around 3-4 mm was made on the drape and connecting tube was then applied over it which was connected to the negative pressure pump delivering an intermittent negative pressure of −125mmHg. Total cycle was of 7 minutes in which pump was on for 5 minutes followed by 2 minutes off.

Depending upon the amount of slough present on each dressing, serial debridements were done under local anaesthesia prior to application of next VAC dressing.

VAC dressing was changed every 4th day and standard wound dressing was changed daily. In both the groups, wound was photographed every 4th day and the size of the wound was measured by Vernier calliper. Wounds were also assessed for presence of any sign of infection and swab stick sample from the wound was also sent every 4th day for bacterial culture and bacterial load. All these parameters were assessed on day 0, day 4th, day 8th and day 12th in both the groups. Postoperatively intravenous antibiotics i.e. 3rd generation cephalosporins (Ceftriaxone 1 gm I.V twice daily) for gram positive coverage and Aminoglycoside (Amikacin 500 mg I.V twice daily) for gram negative coverage were administered initially to all the patients and then were changed according to culture and sensitivity reports. All these antibiotics were continued till there was complete wound healing and complete graft/flap uptake.

Fig. 1: Technique of vacuum assisted closure application

(A) Prepared wound bed

(B) Application of open- pore polyurethane foam

(C) Sealing with adhesive drape and opening for connecting tube

(D) Placement of connecting clamp

(E) Sealing of connecting clamp with adhesive drape

(F) Connecting suction tube

(G) Connection to negative suction pump (E-VAC system)

Following 1st dressing after 5 days of skin grafting/flap cover, patients were discharged and were followed up regularly at 2 weeks, 6 weeks, 12 weeks and then at 6 months. Results were made on the basis of the analysis of following between the two groups:-

1. Whether slough and discharge present or not.
2. Rate of decrease in size of wound (%).
3. Effectiveness of reduction in bacterial load.
4. Time taken by wound to get optimized for skin grafting/ flap cover.
5. Complications in both groups.

Rate of decrease in size of wound (%) from baseline i.e. day 0 to completion of therapy was calculated as following:

$$\text{Rate of decrease in size of wound} = \frac{(\text{Size of wound at baseline} - \text{Size of wound after therapy})}{\text{Size of wound at baseline} \times \text{Total duration of therapy (in days)}} \times 100$$

Results

The mean age of the patient in the VAC therapy group was 34.12±11.01 years and in the standard wound therapy group was 29.73±12.75 years.

There was a male preponderance in both the groups with 12 males (80.0%) in the VAC therapy group and 11 males (73.3%) in SWT group.

The most common mode of injury was road traffic accident with 12 patients (80.0%) in the VAC therapy group and 11 patients (73.3%) in the SWTgroup, followed by fall from height with 01 patient (6.6%) in the VAC therapy group and 03 patients (20.0%) in the SWT group, followed by machinery injury with 02 patients (13.3%) in the VAC therapy group and 01 patient (6.6%) in the SWT group.

At day 12, after respective therapies, slough was present in none of the patient in the VAC therapy group whereas it was still present in 03 patients (25.0%) in the SWT group. Discharge was present in only 01 patient (11.1%) in the VAC therapy group whereas it was still present in 04 patients (33.3%) in the SWTgroup. Bacterial growth was found in only 01 patient (11.1%) in the VAC therapy group whereas it was still found in 03 patients (25.0%) in the SWT group.

The mean rate of decrease in size of wound by VAC therapy was 1.5453 ± 0.5855% whereas by SWT was 1.0587 ± 0.3637%.

The mean time taken by wound to get optimized for coverage by VAC therapy was 10.13 ± 2.55 days whereas by SWT was 11.20±1.65 days.

In terms of type of coverage required, in the VAC therapy group, 11 patients (73.3%) required skin grafting and 04 patients (26.7%) required flap coverage to the wound. In the SWT group, 10 patients (66.7%) required skin grafting and 05 patients (33.3%) required flap coverage to the wound. Further all the patients which required flap coverage to the wound in both the groups i.e. 04 patients (26.7%) in the VAC therapy group and 05 patients (33.3%) in SWT group, were of grade IIIB compound fracture except 01 patient (6.66%) in the SWT group which was of grade IIIA compound fracture.

In terms of complications, superficial infection was seen in 01 patient (6.6%) in the VAC therapy group and in 03 patients (20.0%) in the SWT group. Deep infection was seen in 01 patient (6.6%) in the VAC therapy group and in 02 patients (13.3%) in the SWT group.

Discussion

Compound fractures are surgical emergencies. Debridement of all the dead and necrotic tissue can result in large soft tissue defects precluding healing through delayed primary closures or secondary intention.[1]

Although non-operative modalities like hyperbaric oxygen have been proved to enhance wound healing, however these facilities may not be available to all patients necessitating the need to find an alternative treatment for wound management.[5]

In our study, when patients presented to the hospital (day 0), slough was present in 08 patients (53.3%) in the VAC therapy group and in 10 patients (66.7%) in the SWT group. By day 12th, slough was present in none of the patient in the VAC therapy group whereas it was still present in 03 patients (25.0%) in the SWT group. Our results are constituent with the findings of study done by Morykwas et al and Banwell et al who also found superior results in patients receiving VAC therapy.[7,10]

When patients presented to the hospital (day 0), discharge was present in 13 patients (86.7%) in the VAC therapy group and in 12 patients (80.0%) in the SWT group. By day 12th, discharge was present in only 01 patient (11.1%) in the VAC therapy group whereas it was still present in 04 patients (33.3%) in the SWT group. Morykwas et al and Banwell et al in their study also found superior results in patients receiving VAC therapy.[7,10]

Bacterial growth was found in 09 patients (60.0%) in the VAC therapy group as well as in 09 patients (60.0%) in the SWT group on day 0. By day 12th, bacterial growth was found in only 01 patient (11.1%) in the VAC therapy group whereas in the SWT group, it was found in 03 patients (25.0%). Morykwas et al, Sinha et al and Banwell et al in their study also found increased clearance of bacteria from infected wounds using VAC therapy.[7,9,10]

The mean rate of decrease in size of wound was 1.5453 ± 0.5855% by VAC therapy whereas by SWT was 1.0587 ± 0.3637%. Our results are again consistent with the findings of study done by Morykwas et al, Sinha et al and Banwell et al who also found that VAC therapy helps in reducing the size of wound at much faster rate as compared to SWT when applied to wounds resulting from open fractures.[7,9,10]

In our series, the mean time taken by the wound to get optimized for coverage in the VAC therapy group was 10.13 ± 2.55 days whereas in the SWT group was 11.20±1.65 days. Our results are again somewhat comparable with the findings of study done by Arti et al who also found less time taken by wounds to get optimized for coverage treated by VAC therapy as compared to SWT.[11]

In terms of type of coverage required, in the VAC therapy group, 11 patients (73.3%) required skin grafting and 04 patients (26.7%) required flap coverage to the wound. In the SWT group, 10 patients (66.7%) required skin grafting and 05 patients (33.3%) required flap coverage to the wound. Further all the patients which required flap coverage to the wound in both the groups i.e. 04 patients (26.7%) in VAC therapy group and 05 patients (33.3%) in SWT group, were of grade IIIB compound fracture except 01 patient (6.66%) in the SWT group which was of grade IIIA compound fracture. So in our study we have found that VAC therapy plays significant role in wounds upto grade IIIA compound fracture, where it accelerates rate of granulation tissue formation and reduces the overall need for flap cover but has no role in wounds of grade IIIB compound fracture where bone is exposed along with periosteal stripping, so ultimately flap coverage is required.

In terms of complications, superficial infection was seen in 01 patient (6.6%) in the VAC therapy group and in 03 patients (20.0%) in the SWT group. Deep infection was seen in 01 patient (6.6%) in the VAC therapy group and in 02 patients (13.3%) in the SWT group. Our results are again constituent with the study by Ketan et al who also found lesser number of complications in patients receiving VAC therapy as compared to patients receivingSWT.[8]

Fig. 2: Vacuum assisted closure therapy case

(A) Pre-op X-Ray

(B) Initial wound

(C) Wound after Debridement

(D) Application of VAC dressing

(E) After 1st VAC dressing (04th day)

(F) After 2nd VAC dressing (08th day)

(G) After 3rd VAC dressing (12th Day)

(H) After skin grafting

(I) At 06 Months final follow up

Fig. 3: Standard wound therapy case

(A)Pre-op X-Ray

(B) Initial wound

(C) Wound after debridement

(D) With standard wound dressing

(E) Wound at 04th day

(F) Wound at 08th day

(G) Wound at 12th Day

(H) After skin grafting

(I) 06 Months final follow up

Conclusion

Our study concludes that Vacuum-assisted closure therapy is a better treatment option as compared to Standard wound therapy in terms of rate of decrease in size of wound, early alleviation of bacterial growth, lesser infection rate and shorter time for wound to get optimized for coverage.

Considering the role of VAC therapy in wound coverage, our study has found that VAC therapy reduces the overall need for flap cover in wounds upto grade IIIA compound fracture but has no role in wounds of grade IIIB compound fracture, where bone is exposed along with periosteal stripping, so ultimately flap coverage is required.

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