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Vacuum Assisted Closure (VAC) Dressing As a Mode of Management in Post-Operative Infected Wounds

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ABSTRACT: Objective: To study theinfectedpost-operativewoundmanagement by Vacuum Assisted Closure (VAC) therapy.
Results: In this study, infected wounds following orthopedic surgery in the orthopedics department. The cases studied are the patients who were admitted in Narayana medical college and hospital.Thirty patients were included in this study from August 2018 to December 2020 with post-operative infected wounds. There is healthy wound healing in all the cases after regular sterile vacuum assisted dressings.
Conclusion: In this study of Vacuum assisted closure therapy, enhanced formation granulation tissue leads to better healing of the wound and a promised recovery. Thus, VAC is a promising new technology in the field of wound healing with multiple applications in a variety of wounds and can be used in both acute and chronic wounds, salvage procedures, or as an adjuvant therapy to improve the results of various surgical procedures.
Keywords: Post-operative infected wounds, VAC dressing, wound healing

I. INTRODUCTION

Management of infected wounds especially postoperative infected[1] wounds is still a big challenge even when medical technology and literature has reached its pinnacle.Vacuum assisted closure dressing is a kind of negative pressure wound therapy (NPWT). VAC applies constant sub atmospheric pressure on the wound & results in effective reduction of excess of interstitial fluid from wound then by reducing bacterial proliferation and wound infection.It also increases blood supply to area adjacent to wound results in acceleration of granulation tissue formation and prepares the wound for the closure.

Negative pressure wound therapy was initially described by Morykwas[3,14] et al. in 1997, and it became the common treatment modality in many clinical settings. The Negative pressure wound therapy effectiveness in chronic wounds, diabetic wounds, and pressure sores was illustrated in several studies. Large and complicated wounds constitute a significant surgical problem. The treatment duration is usually long-lasting, but the number of complications and therapy failures were significant, and one should remember that the treatment costs were high. There are several methods in which Negative pressure wound therapy is one of them, which gives better treatment results in case of post-operative infected wounds. Bacterial infection[13] constitutes a significant problem in case of extensive wounds. These infections not only result in the deterioration of local healing conditions but also negatively influences the patient's general condition and lead towards the development of sepsis.

Vacuum-assisted closure applies constant sub-atmospheric pressure on the wound, which results in effective removal of excess interstitial fluid from the wound, thereby reducing bacterial proliferation and wound infection[2]. It also increases the blood flow to the area adjacent to the wound resulting in the acceleration of granulation tissue formation and prepares the wound for closure[3].

Wound healing was divided into first and second intentions by the surgeons. In first or primary intention closure, the wounds are sealed immediately with simple suturing, skin graft placement, or flap closure. In secondary spontaneous intention, closure wound is sealed without active intent. They are usually associated with highly contaminated wounds and will close by re-epithelialization, which results in contraction of the wound. Delayed primary closure implies wound closure by tertiary intention. The contaminated wound is initially treated with repeated debridement, systemic antibiotics[5], and wound

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closure methods for several days. Surgical intentions such as suturing[6], skin grafting, or flaps were performed once the wound is assessed as ready for closure.

II. MATERIALS AND METHODS

This is a prospective study in which 30 patients were assigned to study group (VAC therapy).Thirty patients were included in this study from August 2018 to December 2020 with post-operative infected wounds. The patients mean age was 52.7 years in this study. The patients underwent following investigations before the therapy: Complete blood picture, Random blood glucose levels, renal function parameters, C-Reactive Protein, Radiographs of the affected limb, Culture and sensitivity report of the pus/ discharge from wound. All cases were followed up-to discharge.

Inclusion criteria for this study is the patients who are presented with infected wounds following surgery in the department of orthopedics during the study period.

Patients who are diagnosed with Malignancy, presence of raw area over blood vessels and nerves, An Untreated osteomyelitis were excluded from the study criteria.

III. TECHNIQUE:

After Surgical debridement of necrotic tissue, fracture fixation and, adequate haemostasias achieved, sterile, open-pore foam dressing placed into wound cavity or on wound. For wound dressing we used a medium density polyvinyl alcohol (PVC) sponge. Sterile Sponge was placed over the wound with a piece of steridrape. Wound margins were sealed with a sterile adhesive steridrape and goal is to extend the drape at least 5 centimeters beyond the margin of wound edge. A perforated tube supplied with suction drain is passed through the sponge so that it lies in the middle of the sponge. The tube should not come in contact with the wound or the drape on the surface. The site where the suction tube exits out should be sealed tightly as it is prone to leak and VAC may not work effectively

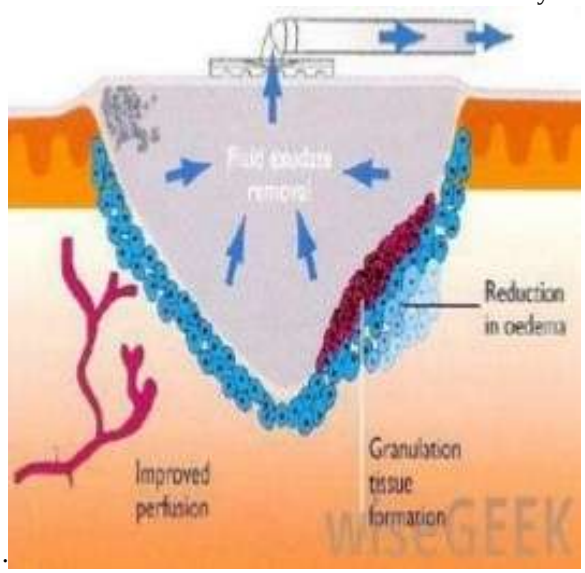

Figure 3: Mechanism of VAC therapy

The suction tube of the drain is connected to the vacuum suction device that provides a negative pressure of suction of 125- 150 mmHg. Negative pressure is applied intermittently like turned on for 30 minutes and off for 30 minutes. After the application VAC dressing and turning on suction the foam collapses onto the wound and by the negative pressure sponge absorbs the secretions from the wound.

IV. OBSERVATION:

In this study the patients age is ranging from 32-78 years, the mean age group was 52.7 years, with a sex ratio of male: female ratio is 7:3.

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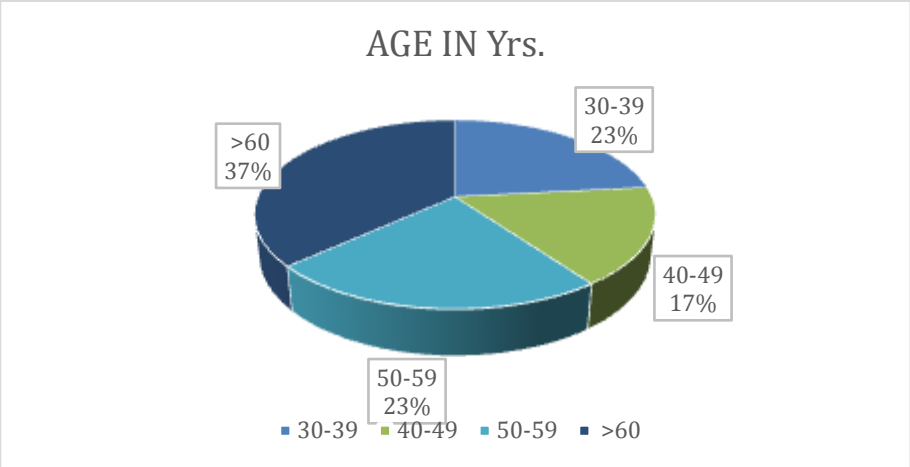

Figure 1: Age distribution

This study comprises of postoperative wounds that are infected. They are radius & ulna (9 cases), humerus (4 cases), femur (7 cases), tibia (7 cases), spine (1 case), calcaneum (1 case) and metatarsals (1 case). This distribution is represented in the form of a graph in figure 2. In percentages for a total of 30 cases.

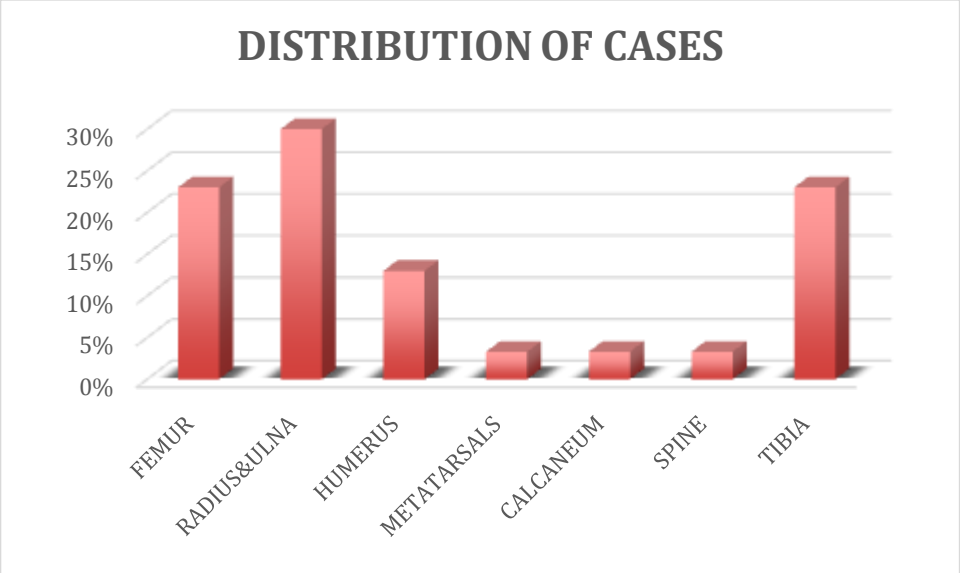

Figure 2:Cases distribution

The dressings were changed after 48 to 72 hrs. depending upon the amount of drain, soakage of sponge and suction action of sponge. The duration of application of VAC therapy in days is represented in a graph in figure 3.

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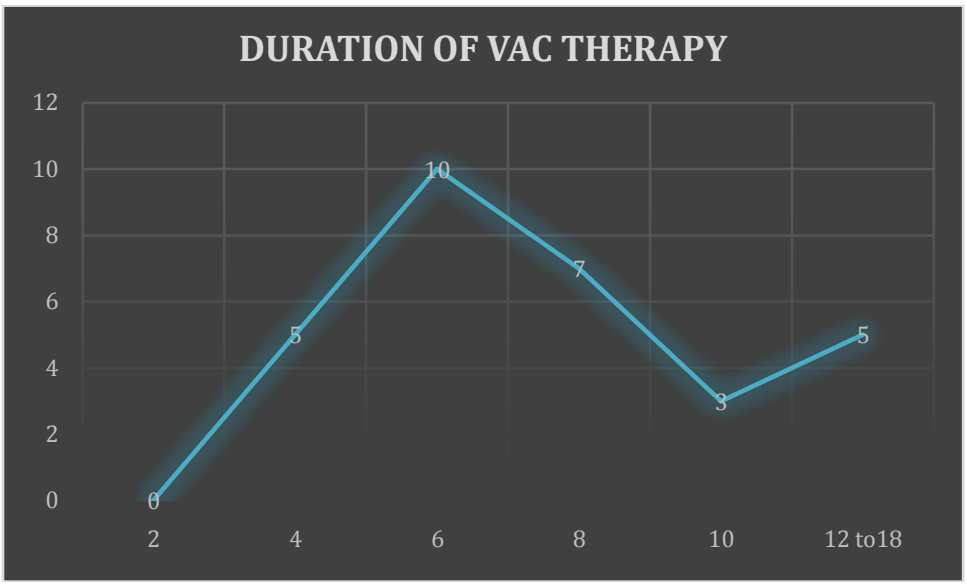

Figure 4: Application of VAC therapy in days

Wound healing is evaluated by the amount of granulation tissue, culture and sensitivity report, Clinical findings. The initial size of the wound margins was measured using a steridrape over the raw area and then marking the wound margins with marker. Calculated the margins by considering the maximum length and breadth over the steridrape. Wound size before Vacuum assisted closure therapy was compared withmargins after therapy.

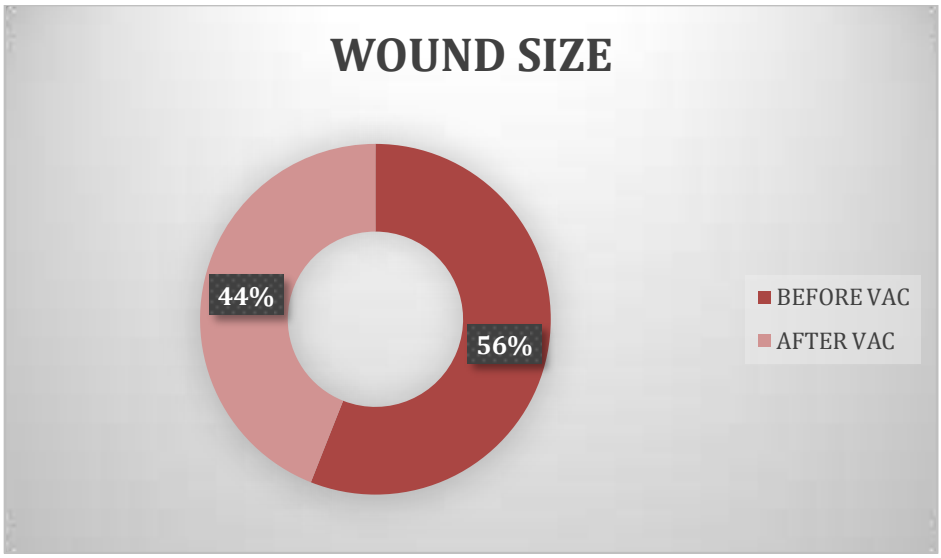

Figure 5: Wound size before and after application of VAC therapy

After the start of wound healing with a good granulation tissue, split skin grafting or secondary suturing of the was done.Infection was assessed on the basis of clinical signs and symptoms that included increasing drainage and pain, purulent discharge and increasing erythema.

V. DISCUSSION

In orthopedics, after the implant surgery, the surgical site infection is a disaster for both patient and surgeon.This leads to prolonged hospital stay, increased use of antibiotics, repeated debridement's, prolonged rehabilitation and may results in increased morbidity and mortality in fracture fixation devices.At beginning of the 19th century, the rate of infection was decreased due to

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the use of antibiotics and basic aseptic measures.In the majority of orthopedic infections, the most common infecting organism is Staphylococcus aureus.

The pathogenesis of infection is related to microorganisms Whose eradication is difficult as they grow in the bio films.Wound healing can be an uncomfortable and painful process that may at times lead to infection, hospitalization and even death of the patient.Throughout the years, attempts have been made to make this process more manageable for patients, as well as clinicians. In fracture fixation devices, the pathogenesis of infection is related to microorganisms whose eradication is difficult as they grow in biofilm. These are classified into three stages; they are early (< 2 weeks), delayed (2- 10 weeks), and late (> 10 weeks)[11,12] decreased, thereby decreased exposure of the wound to the external environment

In 1993, negative pressure was first described with the intention of wound healing and by 1997 was being utilized in the clinical setting. The purpose of this literature review is to identify the available evidence for the use of vacuum assisted closure (VAC) therapy and the extent of its applications.

NEGATIVE PRESSURE WOUND THERAPY:

Vacuum-assisted drainage is used to remove blood or serous fluid from a wound or operation site. Negative pressure therapy with vacuum-assisted closure is a sophisticated development of a standard surgical procedure. Morykwas and Argenta determined that wound healing is promoted by improving blood flow, granulation tissue growth, and nutrition flow while reducing bacterial levels.

a) Blood flow changes: The increase in vascularity mechanism was not yet understood clearly. An increase in the perfusion enhances the healing by bringing oxygen and nutrients to tissues and removes the waste products that interfere with wound healing. Borgquist[16] et al. studied the effects of NPWT on the blood flow Using laser Doppler examination and demonstrated that there is decreased blood flow close to the wound and increased flow farther out. Blood flow depends upon, the pressure applied, tissue type, and the distance from the wound edge.
b) Fluid removal: Oedema in the wound bed increases the pressure in the tissues, resulting in capillary inflow and impeding venous and lymphatic drainage. VAC dressing aids in the removal of oedema and improves capillary blood flow, which increases the oxygen delivery and nutrients to the wound.
c) Limitation of bacterial proliferation: Wounds treated with negative pressure dressings shows a decrease in the bacterial load after 3-4 days. A bacterial count of less than 10^5 organisms[13] per gram of tissue Successful wound healing.
d) Micro deformation: The application of micromechanical forces promotes cell division, angiogenesis, and local elaboration of growth factors.
e) Macro deformation: Considerable shrink in size of the wound is occurs when a negative pressure therapy is applied.
f) Favorable milieu: When negative pressure is applied to a wound, there is an increased rate of cell mitosis, new blood vessel formation, and recruitment of adjacent cells.
g) Wound isolation: The occlusive dressing completely isolates the wound anddecreases the secondary contamination from the environment.

Advantages with application of vacuum assisted closure dressings are removal of interstitial fluid by decreased localized oedema, increases blood flow, enhances of epithelial migration, and frequency of dressings to change are decreased thereby decreased exposure of wound to external environment.Associated with few disadvantages also like pain and discomfort due to suctioning effect, Allergic to adhesive drape, Noise of VAC therapy, maintenance of constant atmospheric pressure, leak of air.(19 cases) excellent results and 36.6% (11 cases) good results with no poor results.

CONTRAINDICATIONS TO VAC THERAPY:

1.Ischemic tissue/ Necrosis: VAC should not be applied to the ischemic wounds until the wound has been revascularized.

2.Fragile skin: Before applying VAC, therapy skin condition should be examined. During dressings, when the adhesive dressing is lifted from the skin, the patient with thin skin due to age, chronic corticosteroid uses, or secondary to a collagen vascular disorder can experience shearing.

3.Presence of malignancy: whenever neoplasm is suspected, it should be excised with adequate margins prior to the application of VAC, as a direct application of VAC on patients with neoplasm may stimulate further tumor growth.

4.Osteomyelitis/ Fistulas: before the application of VAC on wounds where devitalized tissue is present, especially in the case of osteomyelitis, all dead tissue, including dead bone, must be removed because the presence of devitalized tissue serve as a medium for bacterial growth and thus impedes

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healing. The negative pressure may also cause more fluid leakage through the fistulous tract leading to delayed healing of the fistula

These results were compared to other studies. BurkhardLehnar[15] et al. (2011) experienced NPWT and instillation in the treatment of infected orthopedic implants in the sample size of 32 cases. Jens Klem[11] et al. (2009) applied VAC in the treatment of early hip joint infections on a sample of 28 cases.

In this study, 30 cases were analyzed, out of which 21 cases were males, and 9 cases were females. In studies done by Burkhard et al. on 32 cases, 18 were males, and 14 were females. Jens Klem et al. in his study on 28 patients' males and females were 11 and 17 respectively. In the study of Scott W et al., there were 5males and 6females in a total of 11.

In the present study average day of diagnosis of the infection was 7thday with four days as a minimum and a maximum of 2 months. In 8 cases, culture and sensitivity reports stated as no organism isolated even after 48 hours of aerobic incubation. In the remaining 22 cases, different organisms were isolated, and drug sensitivity reports were given. The majority of cases were reported to be infected with Staphylococcus aureus.

In this study, a mean of 3.9 VAC dressings was applied with a minimum of 2 and a maximum of 8 dressings, when compared to the series of 0 5 10 15 20 25 PS BS JK St No. of Cases Study of authors Males 0 10 20 30 40 50 60 70 80 PS BS JK St Mean Age Authors comparison of mean age of cases in different studies, mean age 49 BurkhardLehner et al. where mean dressings were 3.5 ranging from 1-8 dressings.

In our study, out of 30 cases, 17 cases healed with secondary suturing and 13 cases with split skin grafting and no cases required flap coverage. None of our patients had re-infection or lost follow up. In this study, we had a 100% success rate with 63.3% (19 cases) excellent results and 36.6% (11 cases) good results with no poor results.

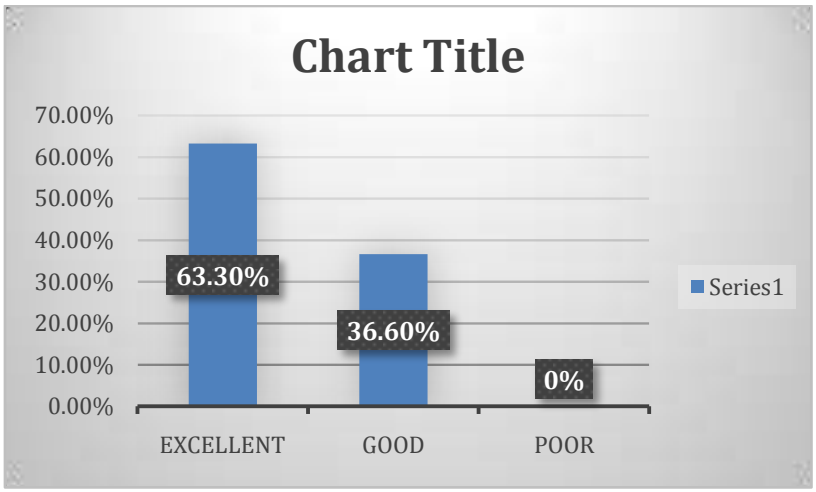

Figure 6: Results of study

VI. SUMMARY

In this study, 21 were males, and 9 were females. Infection was identified in the early phase of the postoperative period, and appropriate antibiotic drugs are started, debridement is done priorly, and VAC therapy is applied. The average VAC dressings number applied was 3.9, and no patient received more than eight dressings. In this study, the intermittent type of VAC therapy applied with a vacuum pressure of 120 mmHg was applied for 30 minutes on and 30 minutes off. The mean size of the ulcer before and after VAC therapy was 44 cm2 and 27.5cm2, respectively, with a reduction in the size by 16.5 cm2, which shows that there is a 55% reduction in the size of the wound. No patient had undergone implant removal, and there was a successful closure achievement in all the cases with retention of implants. The limitations of this study are that this is a prospective, observational study without any control group and short follow up period.

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CASE – 1

INFECTED POSTOPERATIVE WOUND BEFORE APPLYING VAC, WOUND WAS DEBRIDED

VAC DRESSING APPLIED

FOLLOWING MULTIPLE REGULAR VAC DRESSINGS WOUND SIZE DECREASED AND HEALTHY GRANULATION TISSUE APPEARED

VII. CONCLUSION

Initially negative pressure wound therapy was introduced for the management of sub-acute and chronic wounds.As the results were so encouraging, the application was rapidly increased. At present, VAC therapy is used on almost every type of wound.

VIII. ACKNOWLWEDGEMENT

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