Original Research Paper

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Cost-Effective Vacuum Dressing in Orthopaedic Wounds

Orthopaedic

KEYWORDS: Vacuum Assisted dressing, sponge [foam], Orthopaedic wounds, Ioban; commercial adhesive material.

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ABSTRACT

Introduction; Traumatic wounds have been a major cause of morbidity and disfigurement. However no consensus is available on which is the best method for wound management; ranging from regular daily gauze dressing and use of various pharmaceutical agents to highly sophisticated equipments and expertise. The patients in our hospital, mostly belong to the lower socio-economic strata and cannot afford the commercial Vacuum dressings. So we felt the need to develop this technique of doing Vacuum dressings using locally available material. Our aim and objectives is towards assessment of technique with associated complications. Through our study in 20 patients, it can be inferred that our method is cheaper, cost-effective and reproducible.

Material and Methods; we have used this technique in twenty patients. Materials used for the Vacuum dressing comprise of a sterile sponge (foam) with length and breadth according to the size of wound and height of 2cm, a sterile IV set and a self adhesive material like 3M Ioban™. In our method, after primary debridement of wound, first Vacuum dressing was applied in OT and subsequent ones were changed in wards while taking strict aseptic precautions.

Results: In our study, the minimum aged patient was 24 years old and the maximum aged patient was 75 years old with an average age of 47.90 years. 40% patients' sustained injury to foot followed by 30% injuries on leg and 10% injuries we on ankle and knee. 13 patients underwent split skin graft surgeries and 07 patients underwent secondary suturing as final treatment modality after average three vacuum dressings. We did not find any complication related to the material used.

Conclusions: The application of Vacuum dressing is simple and awareness will allow its utilization more often. Based on the technique as described in this study and literature available, it is a promising technology for care of a variety of Orthopedic wounds and at an affordable cost.

Introduction:

Since time immemorial, traumatic wounds have been a major cause of morbidity and disfigurement. This devastating problem often cripples the patients, many of whom are in the prime of their working years, which is of great significance in the developing country like India. There are various factors, which cause delay in healing of wounds like diabetes, infection, old age, malnutrition, ischemia & so on. In a developing country like ours, lack of hygiene, poverty, negligence invariably plays a major role in development and later chronicity of this condition. Postoperative wounds also play major role in morbidity of patients.

There are various methods of management available[1]; however no consensus is available on which is the best method for wound management; ranging from regular daily gauze dressing and use of various pharmaceutical agents like Iodine, EUSOL, Hydrogen Peroxide and Normal Saline to highly sophisticated equipments and expertise.

Vacuum dressing is a therapeutic technique used for promotion of wound healing in acute or chronic wounds in orthopaedic trauma [2,3]. It is established technique commercially available worldwide. It involves creating controlled sub-atmospheric pressure applied locally over the wound by a sealed dressing attached to a Vacuum machine [4]. It is also called as Negative Pressure Wound Therapy [NPWT].

In this study, we attempt at achieving Vacuum Dressing using materials easily available in the market. The patients in our hospital mostly belong to the lower socio-economic strata and cannot afford the commercial Vacuum dressings. So we felt the need to develop this technique of doing Vacuum dressings. Through our study it can be inferred that our method is cheaper, cost-effective and reproducible when compared to market available Vacuum dressings.

The device is a non-invasive system, where one unit delivers negative pressure onto the wound bed through a drainage tube, which decompresses a sponge of polyurethane in an intermittent manner. The wound fluid drains into a container. Dressings are usually changed every third day for inspection of wound. It is attached to central suction unit which is noiseless. It can be also attached to mobile suction unit noisy or noiseless.

We have not used any control group as vacuum dressing is already established method and it has its own advantages over regular dressing.

Materials and Methods:

Dressing material required for our study primarily has two components, a local dressing material and suction machine routinely available in wards or a Central vacuum line. Materials used for the Vacuum dressing comprise of a sterile sponge (foam) with length and breadth according to the size of wound and height of 2cm, a sterile IV set and a self adhesive material like 3M Ioban™ and sterile dressing pads **(Figure I).** This polyurethane sponge is readily available in Hardware or Furniture shops at affordable cost.

20 patients were included in this study.

In our method, after primary debridement of the wound, first Vacuum dressing was applied in OT **(Figure II)** and subsequent ones were changed in wards while taking strict aseptic precautions.

Technique:

Foam is sterilised by autoclave machine or by ETO.A sterile foam sponge is cut into desired size and shape to be placed over the wound. A slit is made in the sponge. A sterile IV set is taken and multiple holes are made into its lumen to enable suctioning when negative pressure is applied by vacuum. The IV set plastic tube is placed inside the sponge. Surrounding area of skin is painted with tincture benzoin and 3M Ioban™ is applied covering 2cm skin margins from wound covering the sponge and creating an airtight seal around the wound, distal end of the intravenous tube is connected to the wall suction apparatus or portable suction machine. Continuous negative pressure (100 to 150 mm Hg) was uniformly applied to the wound and function is checked on table by directly visualising sponge shrinkage **(Figure III).** In wards, patients and nursing staff were instructed about the monitoring of the Vacuum dressing and pressure over dressing to be maintained between 100 to 150 mm Hg. It is released every two hours for fifteen minutes. After achieving granulation **(Figure IV)**; split skin grafting or secondary suturing was done as per the conditions of wound

In case of blockage of IV set obstructing vacuum, plain saline bolus was injected into the lumen to remove blockage and restore pressure mechanics. Also, any additional dysfunction encountered due to soakage was rectified by applying additional adhesive tape to the dressing. Additionally, two wounds on a single limb can be connected to the same suction apparatus **(Figure V)**.

However, this dressing technique cannot be applied over exposed bones, neurovascular bundles and normal skin; thereby restricting its usage. Also if not properly monitored or properly applied it can cause complications like flare up of infection, smothering of skin **(Figure VI)**, exposed uncovered tendons **(Figure VII)**, superficial bone necrosis **(Figure VIII)**. This proves that it should not be used on exposed tendons, bone which violates basic principles of vacuum dressing.

Results:

Table 1: Distribution according to age group

Age group (years)	Number of patients	Percentage (%)
< 40	7	35
41 - 60	8	40
> 60	5	25
Total	20	100

In our study, the minimum aged patient was 24 years old and the maximum aged patient was 75 years old with an average age of 47.90 years.

40% of patients were in the age group of 41-60 years.

Table 2: Distribution according to Gender

Gender	Number of patients	Percentage (%)
Male	16	80
Female	4	20
Total	20	100

Out of 20 patients, 16 patients were males (80%) and 04 patients were females (20%)

Table 3: Distribution according to location of wound

Location	Number of patients	Percentage (%)
Foot	8	40
Leg	6	30
Ankle	2	10
Knee	2	10
Arm	1	5
Lumbar spine	1	5

40% patients sustained injury to foot followed by 30% injuries on leg. 10% injuries were seen each on ankle and knee with 5% injuries each on arm and lumbar spine.

Table 4: Distribution according to definitive treatment

Definitive Treatment	Number of patients	Percentage (%)
Skin grafting	13	65
Secondary suturing	7	35
Total	20	100

13 patients (65%) underwent split skin graft surgeries and 07 patients (35%) underwent secondary suturing as final treatment modality.

Table 5: Distribution according to number of VACS applied

Number of VACs	Number of patients	Percentage (%)
2	8	40
3	9	45
4	3	15

45% patients benefited after application of 3 VAC dressings followed by 40% patients in whom 2 VAC dressings were beneficial. 15% patients had to undergo for 4th VAC dressing to large size of wound.

Complication like skin smothering was seen in 2 patients, necrosis of tissue in 1 patient and exposed tendons without granulation tissue in 1 patient. No specific complication related with material was found. So it is safe and cost-effective.

Discussion:

Acute or chronic orthopaedic wounds may take longer time for healing. It requires admission or frequent hospital visits for wound management. With conventional methods of dressing, it may take weeks to months to heal the wound. It causes severe physical and emotional stress on patient and family with significant financial burden. So vacuum dressing is developed as best alternative to reduce overall burden on whole healthcare system.

Negative Pressure Wound Therapy (NPWT) or Vacuum dressing uses negative pressure to clear the collected fluid. It promotes granulation tissue formation and angiogenesis which helps in rapid wound healing. It is a non-invasive, non-pharmacological, modern, dynamic system developed in the 1990s. Negative pressure accelerates wound healing to conventional dressing [1, 3]. As the study population includes patients belonging mostly to the weaker socio-economic strata, our method has been devised to maximise cost efficiency while simultaneously maintaining the principles of Vacuum dressing.

At present, the resource Pub Med contains around 6614 and 434 articles with the keywords 'vacuum therapy' and 'NPWT' respectively, so it is a well established method.

VAC therapy is commercial available technique widely used worldwide, but it is costly.

In 1993, the US FDA cleared "VAC therapy" for marketing purposes and use in wounds. In 1993, Fleishmann *et al [2]* reported the use of negative pressure in 15 patients with the intention to improve wound healing. The authors described this method of wound management as an efficient way to promote proliferation of granulation tissue and an effective way to achieve a clean wound bed.

In 1997, Argenta *et al [3]* described the clinical use of the commercial VAC in 300 wounds of varying aetiology of which 296 wounds responded. They found that Vacuum therapy removes chronic oedema with increased localized blood flow and granulation tissue production. They concluded that Vacuum-assisted closure was an extremely efficacious modality for treating chronic and "difficult to treat" wounds.

In 1999 by Morykwas*et al.*[4] suggested that by removing the edema, interruption in the blood flow can be prevented.

Numerous other papers have described the use of VAC in the treatment of a variety of wound types including extensive degloving injuries [5, 6], infected sternotomy wounds[7,8,9], and various soft tissue injuries prior to surgical closure[10], grafting and reconstructive surgery[11].

The successful uses of Vacuum therapy in a variety of non-healing or chronic wounds have also been described. These include a recalcitrant below knee amputation wound and pressure sores [12]& leg ulcers [13].

We used this technique in two cases of exposed tendon and bone. There was some tissue over bone and tendon but it did not work leading to complications of tissue necrosis [Fig.VII, VIII]. Actually it is not complication of local material used but violation of basic principle of vacuum dressing. There was no specific complication found of material. It is safe and cost effective.

In our study we found that average numbers of dressings required are three. So local material has not affected quality of wound healing, using basic principles of vacuum dressing. It can be used at different

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sites both in traumatic or post-surgical complicated wounds [Table 1-5]. We found it safe with readily available cheap material and very effective [Fig. IX].

Local material [foam] is well tolerated by patients. No pain intolerance or any reaction to material was found in our study. Proper monitoring of pressure, functioning of vacuum dressing and emptying of drained material is must.

Cost of dressing using our method amounts to approximately Rs.500 [7-8 dollar] per sitting and a total of about Rs. 1000-1500 [14-21 dollar]. This is approximately 95% cheaper than using materials available in the market which costs around Rs. 6000-7000 [84-98 dollar] per VAC dressing. It enables the treating doctor to reduce total required hospital stay thereby further decreasing the total cost of treatment. Furthermore this method is less painful and infrequent as compared to daily dressings, thus increasing both patient and doctor compliance.

This technique is simple to apply and do not need any special training. It can be used in any surgical setups and at periphery also as local available material is used. Basic principles of vacuum dressing should be strictly followed.

Conclusion:

The application of Vacuum dressing is simple, but requires simple training to ensure appropriate and competent use. Awareness about Vacuum dressing will allow its utilization more often.

Wound showed better outcome when Vacuum dressing was used as one of the treatment modality at an affordable cost. Based on the technique as described in this study and literature available, it is a promising technology for care of a variety of orthopaedic wounds and at an affordable cost.

Conflict of Interest; NO

Figure I:- Material

Figure II: First Vacuum dressing in OT

Figure III: After placing the sponge on the wound with one end of I-V set inserted in the sponge, Ioban is placed over the sponge and air tight seal is created. Following negative pressure is applied to the vacuum dressing, shrinkage of sponge is seen.

Figure IV: Good Granulation Tissue

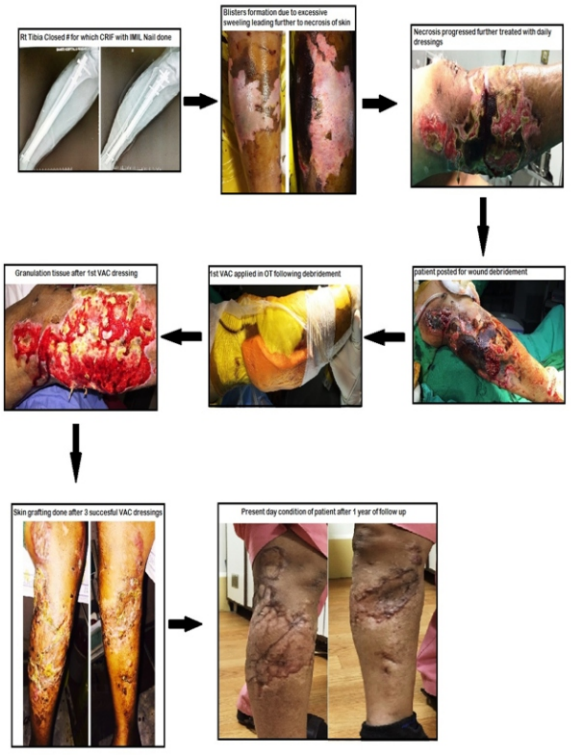
Figure V: Dressing application on multiple wounds using I-V. tubes and 3way, from a single wall suction unit.

Figure VI: Skin Smothering

Figure VII: exposed tendons

Figure VIII: Superficial Bone Necrosis

Figure IX: Case Study



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