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Case Report

Assisted Wounds Closure in the Complex Orthopedic Injury Unit of the Specialties Hospital "Carlos Andrade Marín", Through the Use of PVA Sheets with Negative-Pressure (V.A.C.®) System [Kinetic Concepts Inc. (KCI), San Antonio, TX, USA.], Case Report

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Received: February 25, 2019; **Published:** March 27, 2019

Abstract

Introduction: The scientific article presented below aims to analyze and prove the use of PVA sheets (V.A.C. WhiteFoam dressingTM) with negative-pressure system, as a relatively new technique used in the management of wounds caused by trauma or as a consequence of inflammatory and severe infectious processes.

An attentive, scrupulous and meticulous study is the fundamental axis for the management of these injuries. The formation of dead spaces allows the wound to fill with fluid, which subsequently generates poor scarring, necrosis or re-infection episodes very easily. In the Complex Orthopedic Injury Unit of the Specialties Hospital Carlos Andrade Marín, the following pathologies are frequently managed: musculoskeletal infections, pseudo-arthrosis, limb reconstruction, amputation, among others.

Faced with this situation, the challenge was to achieve the final wound healing avoiding re-infection and dehiscence. We have achieved it thanks to the application of active drainages assisted by negative-pressure obtaining early recovery and low percentage of re-infection in the patients.

It is necessary to emphasize that this unit handles an approximate of 123 cases a year and in most of these patients musculoskeletal infectious lesions are observed.

Case Report: Next, we refer to a case, considered by the Unit as an emblematic example; it is a case of chronic osteomyelitis after a femur fracture.

The patient showed a large wound on the outside of the thigh, with abundant exudate due to osteomyelitis. This emerging situation required a strict control to avoid infection by extracting fluids, stimulating the formation of granulation tissue, forming bridges that allow the closure of the wound in a prompt and timely manner.

Discussion: The assisted wounds closure through the use of PVA sheets with Negative-Pressure System (V.A.C.®) is a useful technique for approaching and closing wounds in patients with chronic osteomyelitis, whose wounds could not be closed during surgery due to the presence of dead space and abundant exudate.

Keywords: *V.A.C.; Osteomyelitis; Post Traumatic Wounds; Wound Closure; PVA; Negative-Pressure Therapy*

Introduction

Negative-Pressure Therapy in wounds is a relatively new technique that was initially approved by the FDA (Food and Drug Administration) for its use in the United States in 1995; it was developed by a plastic surgeon (Dr. Argenta) and originally designed to treat chronic vascular wounds that did not heal in patients who were not candidates for surgery [1]. Negative-Pressure Therapy in tissues currently involves the VAC System [Vacuum Assisted Closure® (VAC®) system - Kinetic Concepts Inc. KCI, San Antonio, TX, USA], which acts in the area of the wound stagnant in the phase of inflammation and proliferation, even in wounds that are in an acute state [2]. Its action mechanism is based basically on three levels: 1. Removal of excess of interstitial fluid, 2. Transmission of mechanical forces that stimulates tissue proliferation, 3. Maintenance of an adequate environment in the wound in terms of humidity and temperature [2,3].

Negative-Pressure Therapy in wounds is a non-invasive healing system that uses controlled and localized negative pressure [4] that consists of a dressing [VAC® GranuFoam™ dressing, which is a black polyurethane (PU) foam containing cross-linked pores; it is hydrophobic, which improves the elimination of the exudate] that is covered with an adhesive sheet [VAC® Adhesive Sheet] [5]. All this is connected to a tube [SensaT.R.A.C.TM Interface] [5] that carries the exudate to an hermetic container with an antibacterial and gelatinizing envelope [Container VAC®, Canister available in two sizes 500 cc and 1000 cc] [5]. Together the aforementioned promotes a fibroblastic migration thus obtaining a better quality tissue, greater granulation and angiogenesis [3] tissue. The effectiveness of the process is given by: 1. Removal of fluids (reduction of pro-inflammatory factors of the extracellular matrix); 2. Increase in capillary blood flow (four times greater); 3. Increase in granulation tissue formation; 4. Promotion of a wet environment; 5. Reduction of local edema; 6. Reduction of dead spaces [6,7].

To achieve a quick and better approximation of the wounds, controlling the exudate they produce and eliminating the dead space, we have used the Assisted Wound Closure technique, through the use of PVA sheets (VAC WhiteFoam™ Dressing) [5] with Negative-Pressure System (VAC®), technique that we have strengthened in the Complex Orthopedic Injury Unit of the Specialties Hospital Carlos Andrade Marín, which is described below:

Description of the "Fries" Technique

a. Control hemostasis and approximate wound edges with separate and equidistant points. Remove dead spaces.

b. Prepare strips of PVA (Dressing V.A.C. WhiteFoam™), of the width that corresponds to the distance between each stitch in the wound (third part of the width between stitches) and the length depending on its depth.

c. Place the necessary amount of "Fries" PVA strips according to the length of the wound, allowing about 3 cm on the skin.

d. Clean the skin of corporal fluids, with saline solution, later with alcohol and wait for it to dry spontaneously. It will allow a better adhesion of the adhesive sheet.

e. Measure the ideal length of the adhesive sheet that allows covering enough skin area to perform an optimal vacuum.

f. Make an eyelet of the size of the wound in the center of the adhesive sheet to allow the wound and the PVA strips ("fries") to be free of the adhesive.

g. Place the sponge of the appropriate size that covers both the wound and the PVA strips (fries).

h. Cover with an adhesive sheet the sponge and the adhesive sheet previously placed.

i. Apply the Sensa T.R.A.C. TM Interface in a central place to allow proper function.

j. Instill the system to the V.A.C.® machine.

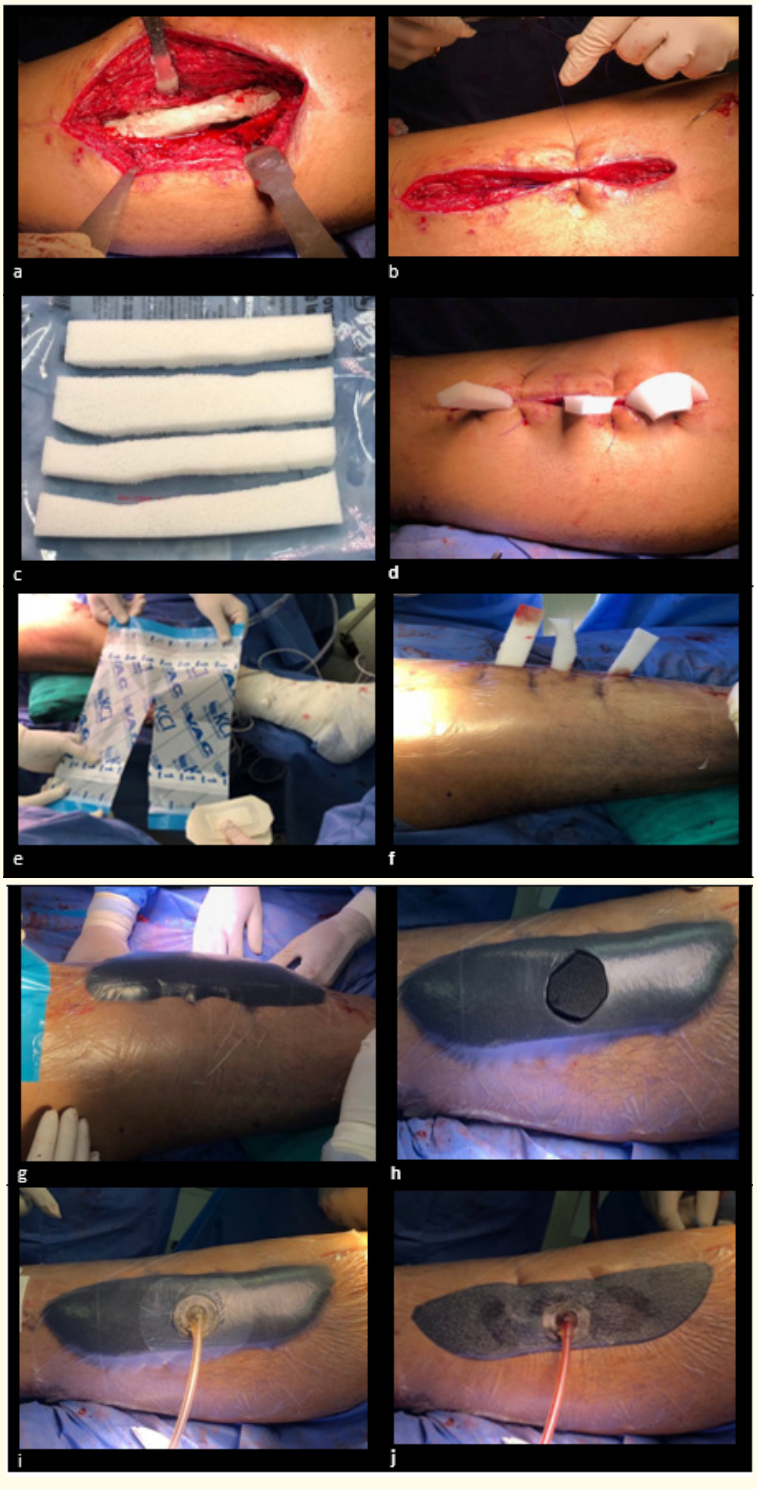
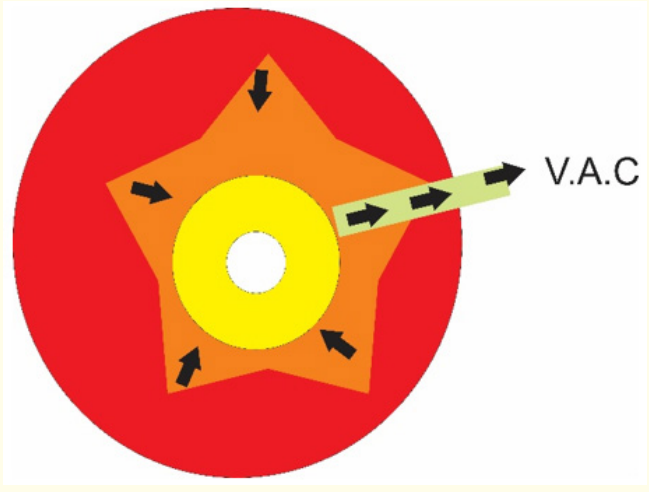


Figure 1: *Images from a to j show "Fries Technique".*



Graph 1: *Mode of action of the dynamic drainage; when generating negative-pressure inside the wound bed, it closes the dead spaces and drains the fluids preventing them from being collected, also promoting healing.*

According to the procedure described above, it is possible to obtain an adequate approximation of the wounds with important dead space and abundant exudate, in a reduced time and maintaining an optimal environment for the formation of granulation tissue. It will create "granulation bridges" when the removal of the PVA Sheets (VAC WhiteFoam™ Dressing) is done after 3 to 5 days of their placement according to the production of exudate obtained, which is considerably reduced or null and indicates the time to proceed the removal.

Wound characteristics
Deep and serious wounds with moderate presence of granulation issue, abundant exudate and dead space
Deep traumatic wounds
Diabetic food ulcers
Dry wounds
Post-grafting (including dermal substitutes)
Ulcers in lower limbs, including venous ulcers in legs and diabetic foot
Ulcers varicose ulcers

Table 1*: Indications for use of the Negative-Pressure System (V.A.C.®).*

Do not place on blind and non-explored spaces.
Always count the number of PVA strips that you place in the wound and carry a record of them.
Do not apply directly on vessels or nerves or vascular grafting.

Table 2: *Precautions on the use of the Negative-Pressure System (V.A.C.®).*

Case Report

20 years male patient with personal pathological history of hypothyroidism in treatment, diaphyseal fracture of right humerus.

AO: 12-A3, Diaphyseal fracture of right femur AO: 32-A2 10 months ago, after falling approximately 11 meters after autolytic attempt, without known allergies, transferred from dispensary to outpatient clinic of the Specialties Hospital "Carlos Andrade Marín ", due to pain and secretion of seropurulent fluid at the level of the distal third of the right femur. Therefore, the patient is admitted to the Complex Orthopedic Injury Unit of the Specialties Hospital "Carlos Andrade Marín" to complete laboratory tests and for surgical resolution. At the moment of the admission the patient is hemodynamically stable; physical examination revealed the presence of a fistula at the level of the distal third of the medial side of the right femur; it was productive with moderate seropurulent secretion, malodor, arcs of mobility limited by pain, neurovascular distal preserved and capillary filling less than 3 seconds; with paraclinical laboratory values within normality. It is decided to perform a removal of osteosynthesis material, reaming of the medullary canal of the femur, plus bone resection and sample taking for culture. The results indicate the presence of: "Klebsiella pneumoniae spp CRE" sensitive only to Tigecycline so a specific antibiotic therapy is started by the Infectology Department of the Specialties Hospital "Carlos Andrade Marín". Because of this antecedent, three surgical cleanings are performed with Negative-Pressure System (V.A.C.®) placement, until negative culture results are obtained and a new surgical intervention is planned. Then, a Masquelet First Time is performed plus PVA Sheet Placement with Negative-Pressure System (VAC®) - "Fries Technique", thus obtaining a controlled environment for the wound; exudate was reduced, infection was prevented, bridges of granulation tissue were formed for the subsequent approximation and wound closure by ulterior motive.

Figure 2: *Evolution of the wound after the use of the "Fries Technique".*

Discussion

Negative-Pressure Therapy or also called Vacuum Assisted Closure therapy (VAC) is used for wound closure that with conventional procedures would present difficulty for their final resolution. Thus, this therapy optimizes times, effectively decreases recurrences and the need for grafting and increases the negativization of results of cultures of cases with infection, being very useful in cases where extensive wounds exist and even with the presence of infection or osteomyelitis. VAC therapy can be widely used in Traumatology, in postsurgical and post-traumatic wounds, pressure ulcers, diabetic foot ulcers and infected wounds. We know the mechanism this system acts: it forms a barrier and a sub-atmospheric pressure for a period of time that allows to remove the excess of liquid and residues which contributes to decrease the bacterial load in the tissues and in turn increases the tissue perfusion, improving the formation of granulation tissue and finally the healing of wounds. The experience in the Complex Orthopedic Injuries Unit (ULOC) of the Hospital Carlos Andrade Marín (HCAM) with very large deep or infected wounds in which the "Fries" technique has been used has allowed to obtain encouraging results which has been reflected in the healing time, more negative culture reports, controlled granulation without hyper-granulation, critical patients were not subjected to recurrent surgical interventions, and it can be withdrawn in hospital without the need of an operating room and a shorter hospital stay. The mechanism how this technique works is the following: it reduces the "dead space" when placing the PVA strips which optimizes the negative pressure creating compartments and in turn maintains a hydrated environment but without accumulation of unnecessary liquid and waste, It causes the approach of the dead space in the places where PVA is not found; when removing the strips, they leave tunnels with optimal granulation tissue for a surgical closure. The use of this technique with presence of osteosynthesis material has not been affected. The important issue above all is the placement of the system after an effective debridement, where the greatest amount of necrotic or infectious tissue is removed, as well as avoiding the placement of the PVA strips (Fries) in deep places without exploring. This makes it possible not to have vascular-nervous complications. It is very important to keep a record of the number of PVA (Fries) strips that are placed so that they are completely removed when the therapy is finished. The pressure used varies between 75 to 175 mmHg [2] depending on the space and the amount of liquid that is being produced [8].

Conclusion

In conclusion, the Fries Therapy proposed in this case report has shown effectiveness in complex wounds where the final wounds closure treated in a habitual way would have an uncertain evolution; it is not considered as an option to replace the debridement of tissues, in place it is a complementary method that potentiates wound healing with extensive areas of injury and/or infection.

Conflict of Interests

Authors declare that they have no conflicts of interests.

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Volume 10 Issue 4 April 2019