WOUND VAC: Tips and Tricks

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INTRODUCTION

Negative pressure wound therapy (NPWT) using the Wound VAC (Vacuum-Assisted Closure®) system (KCI, San Antonio, TX) has become an important treatment modality for a variety of wounds in numerous medical fields and its indications and popularity have significantly grown in the past few years. An excellent review of Vacuum-Assisted Closure in the lower extremity was presented by J. Christopher Benson in the Podiatry Institute's Update 2002. The purpose of this update is to present some adjuncts to the normal application and protocol of the Wound VAC® such as methods to reduce pain, prevent maceration, deal with a difficult location of a wound, and the use of alternative dressings.

PAIN

There are different methods available to help the sensate patient that has pain either with the therapy itself or the foam dressing changes. If the patient is experiencing pain despite attempted management with oral or venous analgesics during the therapy, KCI recommends decreasing the settings by 25 mm Hg increments until pain is resolved.¹ The Intermittent setting can sometimes be painful for the sensate patient and changing to the continuous setting may cause less pain, although it may not enhance granulation tissue as much as the intermittent setting will.

If the patient has pain with sponge dressing changes than there are several techniques that can be used. Obviously, premedicating the patient prior to the dressing change is the easiest measure that can be taken. The more non-adherent white VersaFoam sponge may be used instead of the traditional black GranuloFoam sponge, which will overall be less painful to the patient upon removal, but again may not produce as rapid a rate of granulation tissue formation. Ensure that dressing changes are performed at least every 48 hours for most wounds, as decreasing the frequency of dressing changes will allow ingrowth of granulation tissue into the sponge and therefore is more likely to cause pain upon removal. Daily dressing changes may be necessary for children as they tend to have a rapid tissue response.²

Alternatively, a single-layered non-adherent meshed dressing such as Mepitel or dry Adaptic (not Xeroform, as this is too oily) can be placed first into the wound and then the sponge and drape are placed over this.3 These dressings will allow easier removal of the sponge from the wound. Another option would be to inject Xylocaine (without epinephrine) or a similar local anesthetic directly into the sponge a few minutes prior to removal or soaking the sponge with saline prior to removal.² Topical lidocaine or EMLA® after removal and actual injection of local anesthetic into the wound itself are less frequently used options. If there is pain from sharp debridement at bedside, consider oral analgesics and EMLA placed topically under an occlusive dressing 30 minutes prior to debridement (not an FDA approved procedure, but an accepted use in other countries).3 Sometimes pain can be elicited due to adherence of hair caught in the drape or adhesive, shaving the skin adjacent to the wound can alleviate this problem.

MACERATION

The most common cause of macerated skin edges around a wound receiving NPWT is lack of proper technique. Ensure that bleeding is controlled, the skin margins are clean and dry, the sponge does not extend onto the skin and is well within the wound, that there is a good overlap of the drape onto the skin (at least 4 cm), and that a skin adherent is used around the periphery of the wound.1 Although Tincture of Benzoin and Mastisol have been used in the past, most wound care staff have converted to using skin preparation materials that not only protect the skin, but also remove the oil from the skin enhancing adhesion of the drape. Examples of skin preps used are Allkare (Convatec, which has some alcohol in it and has been know to sometimes cause a stinging sensation) and 3M's or Smith & Nephew's "No-Sting" skin prep (which lacks alcohol and therefore causes no stinging). Also, the physician may also either stop the therapy for a few days or increase the pressure setting to resolve maceration. Use of a skin barrier protectant such as Duoderm or nonadhesive bandage around the periphery and extending the drape beyond these borders to better skin layers is another method. If the toes must be included in the dressing because of the location of the wound, place either cast padding or a small piece of sponge in between the digits to prevent maceration. In a significantly exudative wound with skin maceration, yeast can sometimes become a problem which may require the use of topical Nystatin powder, as well as better maceration control, for treatment.

LEAKAGE

The amount of drape material used should be kept to a minimum to prevent leaks or creases. For small leaks that are hard to find, a skin prep may be lightly spread over the drape, this creates a film over the area and can sometimes effectively enough, seal a small leak in the drape allowing for proper suction. If trying to maintain suction and the toes must be included because of the location of the wound, you can fold the drape from plantar to dorsal like a quesadilla and crimp the medial and lateral edges. This technique may be useful when applying NPWT to a degloving foot injury. If it is difficult to locate the leak, methylene blue dye (1 mg diluted in 500 cc of sterile water) may be applied onto the drape and rinsed after 3 minutes. The blue dye will color the dressing at the site of the leak. This has been termed the "Maya Technique" by its originators.4

SKIN FRAGILITY

Fragile skin or creased skin (such as at the anterior ankle) can also be protected with the use of wound care products such as Duoderm[®] or Tegasorb[®], both of which the drape readily sticks to. If these products are used, the drape must extend past where they end to ensure a good seal. If the skin is becoming fragile or tender due to frequent sponge and drape removal changes, KCI recommends cutting the drape just around the sponge itself, leaving the remainder of the drape on the skin, replacing the sponge and simply applying a new drape overtop of the old one for one additional dressing change only. KCI warns that more than 2 drapes overlaid may impair vapor transmission of the drape.¹

SPONGE CONSIDERATIONS

Adapting the foam dimensions to mirror the wound is an effective way to enhance granulation tissue formation using NPWT. If there is an area in your wound of greater depth than the remainder of the wound, contour the sponge to be deeper at that one area and level with the remainder of the wound to enhance sponge contact to this less responsive area. If dealing with a narrow tunnel or undermined wound, use the white VersaFoam material and cut it to the same dimensions. It is not recommended to use the black GranuloFoam sponge as it more fragile and there have been reported cases of portions of the foam left in wounds causing foreign body reaction and infection. The white VersaFoam sponge is more stable and does not break or pull apart comparatively, which is important for areas that may be difficult to visualize. On a complex wound, it is recommended to document the number and location of separate foam pieces within the wound.1 If more than one person is performing the sponge changes, this documentation can be written on the drape itself to ensure foam pieces are not left within the wound. It is important that the wound not be overpacked with sponge material. Often it may be necessary to split the sponge to half its width. Recently, KCI has begun offering more sponge dimension options that already are pre-cut to different sizes based on possible wound dimensions.

If a white VersaFoam sponge is used, understand that it has less suction power the farther from the area that the suction tube is applied to the sponge because it is a denser foam with higher tensile strength.1 For example, if the suction is applied at the center of a circular VersaFoam sponge, the farther to the periphery of the sponge you go, the less negative pressure suction is achieved. However, the black GranuloFoam sponge has reticulated or open pores, thereby allowing equal suction at every area of the foam irregardless of where the suction is applied. To even out the suction when using a white VersaFoam sponge, either a layer of the GranuloFoam may be placed on top of the VersaFoam or a "zebra-stripe" of the black sponge may be layered over the white foam to enhance the amount of suction at the periphery of the sponge.

For wounds that are smaller than the T.R.A.C.[™] pad, some modifications in the application technique are recommended by KCI (Figure 1). Cut the foam to the wound dimensions, apply to the wound and drape as usual. Then cut a 2 cm hole in the drape over the foam, apply another piece of foam 1-2 cm beyond the dimensions of the T.R.A.C. pad on top of the first foam (the first drape should be of larger dimension than this second foam piece to protect the skin). Lastly, apply the T.R.A.C. pad to the larger piece of foam.¹

If the sponge is to be placed over sutures, staples, or a dehisced wound, KCI recommends covering these first with a non-adherent dressing prior to foam placement (Figure 2). This may protect the suture or staple from becoming lodged into the GranuloFoam. Alternatively,

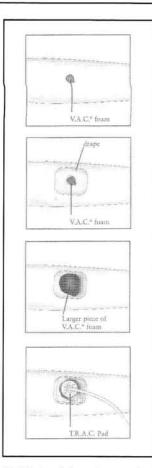


Figure 1. Modified technique for wounds that are smaller than the T.R.A.C. $^{\rm TM}$ pad. $^{\rm I}$

VersaFoam may be used as it is more non-adherent or place a piece of drape over the sutures as the first step, then apply the foam dressings as usual.¹ It is also recommended to protect the intact skin on either side of the incision line with a KCI Drape or Tegaderm. Remove a drape using solvent when it has been placed over staples.

Sponge placement may be combined also with an elastic vessel loop shoelace technique for large soft tissue progressive wound closure and augments the tension created by NPWT. Normal application of the foam is followed by utilizing a large elastic vessel loop that is stapled (staples perpendicular to skin edge with one end in epidermis and one in dermis) to the skin edges in a shoelace fashion over the foam and the drape is applied. The wound is re-evaluated every 48-72 hours and the skin-edges are approximated sequentially using the shoelace vessel loop technique until delayed primary closure is appropriate.⁵ This technique can help avoid closure by secondary intention or grafting.

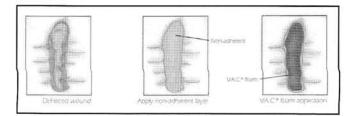
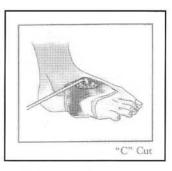
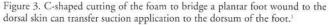


Figure 2. Modified technique for dehisced wounds. Apply a non-adherent dressing prior to foam placement over the wound.¹





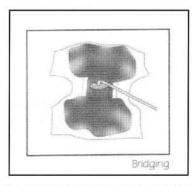


Figure 4. Depiction of bridged wounds, note the centralized application of suction. $^{\scriptscriptstyle\rm i}$

BRIDGING

Bridging between 2 sponges is a technique that may be useful to either incorporate more than one wound to one V.A.C. unit or as a method to bring the suction from a site less assessable to a more convenient site, such as taking suction from a plantar wound to placing the suction at the dorsum of the foot. This may also be a useful method to move tubing away from an area already compromised to prevent breakdown from the tubing itself. Cutting the foam in a C-shape facilitates creation of a plantar to dorsal bridge (Figure 3).¹² Take care to use either a drape or a protective product such as Duoderm under the sponge bridge to protect the intact skin.⁶ Also, apply the tubing or T.R.A.C. pad in a central location for equal suction to both wounds (Figure 4).¹ Do not bridge wounds if infection is suspected.

BACTERIA, ODOR, AND IRRIGATION

NPWT has not been shown to enhance bacterial clearance as originally thought, as evidenced by 2 recent studies in 2004.7.8 Alternatively, many physicians are using silver impregnated wound care products at the surface of the wound as an adjunct to sponge placement and NPWT. Acticoat (nanocrystalline silver-coated dressing, Smith & Nephew), Arglaes (silver powder or film, Medline), and Silversorb (silver gel, Medline) are just examples of what some physicians have used to decrease the bacterial count within the wound while still providing NPWT.2 If a dressing is used, it must be meshed or fenestrated to allow adequate suction of the exudate. Recently, KCI has introduced a silver impregnated sponge called V.A.C. GranuloFoam Silver. If the wound is infected and the physician chooses to continue with NPWT, KCI recommends changing the dressing every 12-24 hours, then resume the normal 48 hour intervals when CFU's drop below 105.1 Obviously, sharp debridement of any necrotic tissue during therapy should be performed when present.

As frequent V.A.C. users are aware, there is a unique odor associated with the interaction of the sponge and the exudates noted on dressing changes. Certainly, if there is a strong malodor one should first rule out an active infection. Wound flushing at dressing changes or use of a silver product may decrease this odor and the bacterial load within the wound. Sometimes it is the machine, the canister, or, in the case of the Freedom V.A.C., the carrying pouch that has absorbed this odor. Changing the canister or, if need be, the machine may resolve this issue. Canisters are available with Isolyser[®] which can reduce odor from the canister itself.¹ If the Freedom V.A.C. pouch has absorbed odor and is the cause of the bad smell, some have suggested placing a dryer sheet in the pouch.

Another available product is the Instill V.A.C. that provides NPWT while enabling the physician to instill local anesthetic or antibiotic into the wound. While different antibiotics have been used most recommend either Clorpactin or a Sulfa preparation. The author has not personally used the Instill V.A.C. product; however, many of the wound care staff do not favor this modality compared to the standard NPWT products in terms of ease of use.

If irrigation of the wound is desired in conjunction with NPWT, a soft red rubber catheter (10 French) can be imbedded into the sponge and clamped off during NPWT. Therapy may be briefly stopped and the wound may be flushed with saline daily utilizing the catheter. Others have advocated using an angio-catheter to continuously instill saline during therapy itself at a rate of around 20 cc/hour. Intermittent flushing or continuous flow of saline into the wound is by no means a standard practice or normally necessary other than at dressing changes. However, some physicians use this as an adjunct to break-up more viscous exudate that might otherwise prevent optimal NPWT.

MINIMAL CHANGE IN WOUND DIMENSIONS

If the wound appears stalled over a 1 to 2 week period, re-evaluate the wound for infection or adequate pressure off-loading and assess the nutritional status of the patient.¹ Additionally, KCI recommends cutting the foam slightly smaller than the wound, performing a "therapeutic pause" of therapy for 1-2 days before re-initiating therapy, changing the Continuous or Intermittent setting to the opposite setting, or removing any epithelial cells from the wound surface if present prior to full-granulation of the wound.¹

PRESSURE SETTINGS

For most foot and ankle wounds using the standard GranuloFoam black sponge, the pressure setting is placed at 125 mm Hg Continuous for the first 48 hours then changed to Intermittent therapy of 5 minutes on and 2 minutes off; as Intermittent therapy has shown to increase rate of granulation tissue formation.1 If using the VersaFoam, the pressure may need to be increased up to 175 mm Hg if there is more drainage. Increasing the setting in 25 mm Hg increments may be advantageous with excessive drainage, large volume wounds, tunneled wounds, or with a tenuous seal. Decreasing the setting by 25 mm Hg increments can be performed if there is bruising in the wound bed, pain, an elderly patient, excessive bleeding, peripheral vascular disease, or excessive granulation tissue formation.1 Start with a lower setting such as 50-75 mm Hg if the patient is emaciated, elderly, on anticoagulants, or over exposed tendon.9 A setting of 75 mm Hg Continuous is more typical when the NPWT is used in conjunction with skin or bio-engineered tissue grafts (5-7 days post-placement of the graft) or as a setting in areas requiring less suction such as adjacent to tendons (like a dehisced Achilles tendon repair incision). Keep the setting on Continuous if dealing with a tunneling wound until the tunnel is closed.1

Settings and protocol compliance are easily monitored in an inpatient situation. When treating an outpatient, the Freedom V.A.C. has an hour log that you can check to see if your patient is being compliant at home and you also have the ability to lock-out the patient from the device and manipulating the settings on their own.

LITERATURE UPDATE

Until the past few years, little research had been performed to ascertain the mechanism by which VAC therapy achieved its positive clinical outcomes. Chen et al recently published an experimental study that showed that vacuum assisted closure promotes blood circulation and reduces edema by increasing capillary caliber and blood volume, stimulating angiogenesis, narrowing endothelial space and restoring capillary basement membrane integrity.10 Saxena et al used a technique called finite element modeling to show that the VAC created tissue microdeformations that may promote cell proliferation, cell division, angiogenesis, and a local increase in growth factors.¹¹ Bacterial load however, does not decrease with VAC therapy as was previously thought, as shown in two articles in 2004, and therefore is excluded as a mechanism by which the VAC improves wounds.7,8

CONCLUSION

NPWT accelerates wound healing in a variety of wound types and clinical situations. Adapting to new applications, adjuncts, products, and complications enables physicians to provide the best quality of care to their patients.

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