

CASE REPORT

## VACUUM ASSISTED CLOSURE OF LAPAROSTOMY WOUNDS “A NOVEL TECHNIQUE”

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Management of a laparostomy wound is contentious. Specific pathologies like severe intra-abdominal sepsis, trauma requiring damage control, abdominal compartment syndrome, staged abdominal repair and other complex abdominal pathologies can be managed with a novel technique of Vacuum Assisted Closure dressing. This device applies sub-atmospheric pressure that leads to reduced bowel wall edema, bacterial count and inflammatory burden found in open abdominal wounds. This leads to a reduced need for frequent dressing changes, maintaining intact skin and improvement in fluid management. Controlled clinical studies are needed to establish the safety and effectiveness of this treatment strategy. We present our experience with this technique suggesting it to be safe and effective. A brief outline of the working of Vacuum Assisted Closure dressing is also presented.

**Keywords:** Vacuum assisted closure, dressing, laparostomy, burst abdomen, open abdomen

### INTRODUCTION

An open abdomen presents numerous challenges for the clinician, particularly in patients with abdominal trauma and intra-abdominal sepsis<sup>1</sup>. The major problem in managing the open abdomen is control of intra-abdominal fluid secretion, facilitation of abdominal re-exploration, and preservation of the fascia for abdominal wall closure. A temporary barrier to maintain bowel integrity, allowing easy re-entry and preventing the development of abdominal compartment syndrome (ACS) is warranted. Vacuum assisted closure (VAC) therapy can potentially decrease the concentration of pro-inflammatory cytokines, bacterial count, management of third-space fluid and improved input and output monitoring.

### CASE

A 29 years female patient was admitted through accident and emergency department with symptoms and signs of an acute abdomen. She had had a diagnostic laparoscopy by gynecologist two days prior to this presentation. After resuscitation, she underwent an emergency laparotomy and an iatrogenic injury of the small bowel leading to generalized purulent peritonitis was found. Drainage of intra-abdominal abscess, resection of the injured small bowel and fashioning of an ileostomy was performed. Patient was septic and required postoperative intensive care.

She failed to improve and had to undergo two further laparotomies for the on-going abdominal sepsis. After third abdominal exploration, she developed a burst abdomen. As the patient was not fit for abdominal closure due to a risk of abdominal compartment syndrome, it was decided to use a VAC

dressing to cover the open abdomen. In the next four weeks she had 12 visits to the operation theatre for change of VAC dressing under general anesthesia (Figures 1,2&3). 125 mm Hg of suction was used for the VAC dressing, applied cyclically, five minutes on and two minutes off, with good effect. The wound healed well (Figure 4) and the patient recovered well and was discharged to the district nurse for regular wound dressings at home. At her last out patient visit, her abdominal wound had healed completely.

**The VAC method of use** (Figure 5)

Steps 1-6 demonstrate the technique for VAC:

#### Step 1

The fenestrated, non-adherent layer foam dressing is cut to the approximate size of the wound with scissors and placed gently over the omentum or exposed internal organs and tucked under the abdominal wall to the lateral gutters. The encapsulated foam helps minimize dressing shift within the abdomen and allows for easy dressing centering.

#### Step 2

A second layer of foam is placed over the non-adherent layer and cut in width to 1 cm of the edges of the abdominal wall. This secondary foam distributes negative pressure over the abdomen. Perforations in the foam enable appropriate sizing of the foam to fit the wound size. One or two layers can be used as required.

#### Step 3

The adherent layer is then applied over the foam in a shingled technique and the surrounding area of healthy skin. Then a 2cm hole is cut to allow placement of the tract pad with a drain. At this stage

it is important to ensure that the membrane forms a good seal both with the skin and the drainage tube.

**Step 4**

The distal end of the drain is connected to the VAC unit, which is programmed to produce the required level of pressure. Suction at 125 to 150 mm Hg is usually applied to the wound intermittently.

**Step 5**

Once the vacuum is switched on, the air is sucked out of the foam causing it to collapse inwards drawing the edges of the wound in with it.

**Step 6**

Fluid within the wound is taken up by the foam and transported into the disposable container within the main vacuum unit.



**Figure 1. Open laparostomy wound**



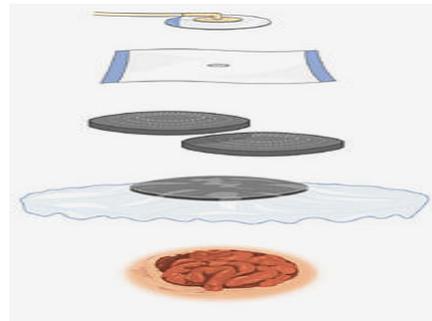
**Figure 2. Wound covered with VAC dressing**



**Figure 3. VAC device**



**Figure 4. Granulating wound**



**Figure 5. Method of placing the VAC dressing**

## DISCUSSION

Although to date no randomized controlled studies comparing one mode of closure to another have been published and no generally accepted gold standard of management of open abdominal wounds is available, the literature contains a number of relevant articles<sup>1</sup>. VAC has been reported to be effective in managing the open abdomen and various approaches, including the Bogota bag<sup>2</sup>, have been used. This technique, first reported in 1984, uses an opened intravenous bag sutured to skin or fascia<sup>2</sup>.

An ideal temporary abdominal closure method should allow for multiple procedures, minimizing abdominal pressure, control third space fluid, preserve fascial integrity and help minimize frequency of dressing changes. Evaluation of most forms of temporary closure devised over the years falls short of a preferred method and many need refinement.

VAC therapy uses specially designed equipment that meets many of these requirements. Collection of third-space fluid loss from the abdomen helps keep patients skin dry and intact. VAC allows the abdominal wall to expand and decreases the potential damage from ACS. In addition, it has a potential to remove pro-inflammatory substances that can lead to further systemic complications. The application of VAC therapy to a wound provides a moist wound-healing environment which is the standard of care for wound healing.

In VAC, a foam is placed directly in contact with tissues under an airtight seal. The evacuation of air from the open cells of the foam causes the foam to collapse on itself and provide a mechanical distraction, or stretching, of the soft tissues. This stretching of tissue stresses the cell's cytoskeleton resulting in increased mitosis and cell proliferation. This process has been demonstrated in nerve tissue, endothelial cells, muscle cells and bone. The Ilazarov procedure and tissue stretch of the uterus and abdomen during pregnancy are more obvious examples of this effect.

Before the concept of abdominal VAC therapy was introduced in 2000, the standard management of the open abdomen was the method described by Barker<sup>3</sup> called "VAC pack" therapy. A plastic bag was placed over the abdominal contents and sutured in. Small perforations in the plastic were made to allow fluid to drain. Suction drains placed over the plastic were attached to wall suction.

VAC appeared to be superior to the vacuum pack technique<sup>4</sup>. By creating sub-atmospheric pressure blood flow to the wound is reflexively increased, bacterial counts in the abdomen are reduced, and positive growth factors in the wound are stimulated. The end result is an influx of white cells and fibroblasts required for adequate wound healing. The wound gradually heals with circumferential contraction and the skin tends to cover the viscera over a varied time period. VAC system applies a more uniform and constant vacuum over the wound than wall suction. Also, the VAC stops suctioning if the canister becomes full to prevent exsanguinations, a feature not found on wall suction.

The observation that intermittent treatment appears more effective than continuous therapy is interesting although the reasons for this are not fully understood. Two possible explanations were advanced by Philbeck et al<sup>5</sup>. They suggested that intermittent cycling results in rhythmic perfusion of the tissue, which is maintained because the process of capillary autoregulation is not activated. They also suggested that as cells which are undergoing mitosis must go through a cycle of rest, cellular component production and division and constant stimulation may cause the cells to 'ignore' the stimulus and may become ineffective. Intermittent stimulation allows the cells time to rest and prepare for the next cycle. For this reason it is suggested that intermittent negative pressure should be used clinically, although some authors<sup>6,7</sup> suggest that this may follow a 48-hour period of continuous vacuum, which can be applied to exert a rapid initial cleansing effect. Microbiological studies compared with control values showed that tissue bacterial counts of vacuum-treated

wounds decreased significantly after four days<sup>8</sup> leading to an improvement in intra abdominal sepsis.

It has since been proposed that the application of sub-atmospheric pressure produces mechanical deformation or stress within the tissue resulting in protein and matrix molecule synthesis<sup>8</sup> and enhanced angiogenesis<sup>10</sup>.

Fabian et al<sup>10</sup> provided further hard evidence for the stimulatory effects of sub-atmospheric pressure on the speedy production of granulation tissue formation<sup>8</sup> and also demonstrated a trend to enhanced epithelialisation.

Smith et al<sup>11</sup>, in a retrospective review, described the use of VAC over a four-year period in 93 patients who required open abdomen management for a variety of conditions. A total of 171 dressings were applied to the wounds of 38 surgical patients and 55 patients with traumatic injuries. The authors concluded that with careful subsequent management good patient outcomes could be achieved and recommended VAC as the treatment method of choice for open abdomen management and temporary abdominal closure.

Integration of the VAC system in the management of laparostomy wounds in patients with compromised wound healing also emerges to be doing well and should be given a chance in such patients to give a stable, healed wound<sup>12</sup>.

## CONCLUSION

VAC therapy is a safe and effective modality in the treatment of an open abdomen. Patients' wounds are kept dry and intact with minimal dressing changes, allowing nurses to efficiently care for these complex and challenging patients in an intensive care setting. Vacuum-assisted therapy also expedites wound closure, thereby minimizing the potential for complications in an open wound. Future controlled clinical studies will substantiate VAC's safety and efficacy profile, as observed in the case reported here.

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