Use of vacuum-assisted closure device in a disastrous form of abdominal sepsis and stoma site infection: Systematic review and report of a case.

Miloš Popović1, Goran Barišić1, Velimir Marković1, Jelena Petrović1, Zoran Krivokapić1,2
1First Surgical Clinic, Clinical Center of Serbia, Belgrade Serbia
2Medical School, University of Belgrade, Belgrade Serbia

INTRODUCTION:

Drainage of wounds after surgery is a long established surgical practice since the introduction of suction drainage in the early 1950's and later the evacuated glass bottle by Redon. In the 1980's, the first 5 articles on negative pressure wound therapy were published in the Russian literature.

Negative pressure was used (75-80 mmHg) in combination with aggressive debridement to significantly reduce bacterial counts in purulent wounds. In 1989, Chariker et al published their experience on topical negative pressure (TNP) therapy in 7 patients with incisional or cutaneous fistulas. They used moist gauze that was placed over the wound surface and a flat drain placed over the gauze covered by a bio-occlusive dressing. The drain was connected to an already existing vacuum line such as a standard hospital wall suction source with continuous suction at approximately 60 to 80 mmHg pressure. This method became known as the Chariker-Jeter technique. Many variations have since then been made on this approach. In the early 1990's, Fleshman et al. introduced suction drainage combined with Redon drainage tubes and foam dressings as the interface instead of gauze dressings. At approximately that same period, a commercially available vacuum-assisted closure device (VAC) was introduced by Argenta and Morykwas in 1993 using polyvinyl-alcohol (PVA)-and polyurethane (PU) ethylene foam dressing (PVA/PU), integrated tubing, and advised pressure settings of 125 mmHg pressure.

Subsequently several other manufacturers joined the competing TNP arena. Important differences between these systems are the filler material used (foam vs nonadherent antimicrobial gauze), the connecting suction catheter (integrated tubing with pressure sensor vs flat drain), and the intensity of the negative pressure (ranging from 50 mm to 125 mm Hg).

SYSTEMIC REVIEW

There are certain cases of complicated diffuse peritonitis when primary abdominal closure is either unadvisable or impossible. In such circumstances creation of an open abdomen or laparostomy is the safest option or the only possible one. Massive contaminations with the necessity of repeated abdominal lavage or edema of the bowel due to high volume fluid therapy in septic patients are common reasons for delayed abdominal closure. The advantages of an open abdomen are: easy access to the peritoneal cavity for drainage, prevention of desiccation of the bowel wall and low method-specific morbidity.

Many different techniques have been described previously, such as the Bogota bag, towel packing with or without suction, mesh, synthetic patches, or a combination of different techniques. Short description of the temporary abdominal closure techniques is provided in Table 1.

A consensus document for the management of the open abdomen was launched in 2005 by an expert advisory panel. In this document, 7 retrospective studies were analyzed on the performance of VAC therapy versus other temporal abdominal closure techniques (static /eg, absorbable mesh, Wittmann patch, and running suture/ or dynamic /eg, Bogota bag and vacuum pack/). These other techniques all use some kind of biologically inert material...
Closure rates between 78% and 93% were achieved with VAC therapy, and the incidence of fistulas was measured (2.6% for VAC vs 7% vacuum pack \(P<0.034\) and 13% for Bogota). In a retrospective study by Wild et al\(^\text{18}\) in patients with open abdominal wounds after surgery for peritonitis, a reduced mortality rate was found compared with conventional open wound packing. Nine different techniques were compared in a systemic review comparing all literature until December 2007 (57 case series) on delayed primary fascial closure in patients with an open abdomen. TNP therapy together with the artificial burr technique (biocompatible material sewn to midline fascia for stepwise approximation) was associated with the lowest mortality rate and the highest facial closure rate. \(^\text{19}\) It was stated in the consensus document released by the World Union of Wound Healing Societies\(^\text{20}\) that extra care has to be taken in patients with bowel anastomoses or enterotomy repairs.

In patients with an open abdomen the major cause of mortality is multi-system organ failure\(^\text{21}\). This may be due to the primary insult or to secondary complications such as intestinal leakage or fistula formation. Vacuum-assisted closure (V.A.C.) systems have been predominantly used for treatment of the open abdomen in trauma patients, especially in abdominal compartment syndrome Simple and easy application, low morbidity, and a high rate of primary fascial closure are the described main advan-

### TABLE 1

<table>
<thead>
<tr>
<th>Technique</th>
<th>Description</th>
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<tr>
<td>VAC (vacuum-assisted closure)</td>
<td>This is a sutureless system. A perforated barrier plastic sheet covers the viscera and a polyurethane sponge or damp surgical towels are placed between the fascial edges. The wound is covered by an airtight seal. This is pierced by a suction drain that is connected to a suction pump and fluid collection system. The negative pressure keeps a tension on the abdominal wall and collects exudates. Commercial systems are available with a pre-packed dressing system with a special drainage tube that can be connected to a dedicated specialized pump. Two opposite Velcro sheets are sutured to the fascial edges. The Velcro sheets overlap in the middle allowing gradual re-approximation of the abdominal wall. This can be done without the need of a general anaesthetic. Dynamic retention sutures. The viscera are covered with a barrier sheet. Horizontal sutures are placed through a large diameter silastic catheter 4 cm from each fascial edge and through the entire abdominal wall in an extraperitoneal plane. These sutures maintain tension and can be gradually tightened allowing re-approximation of the abdominal wall.</td>
</tr>
<tr>
<td>Wittmann patch</td>
<td>Intraperitoneal suction drains to subphrenic spaces and pelvis. Viscera protected with plastic sheet and gauze. Two opposite metal plates are sutured to the fascial edges and maintain tension. The plates interlock in the middle.</td>
</tr>
<tr>
<td>Locking system</td>
<td>A sterile 3 l irrigation bag is sutured between fascial edges or the skin protecting the abdominal contents and preventing retraction of fascial edges. It is cheap, readily available and easy to use.</td>
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<tr>
<td>Bogota’ bag</td>
<td>A biological, absorbable or non-absorbable mesh or sheet is sutured between the fascial edges. As swelling subsides, the meshes or sheet may be reduced in size allowing for gradual re-approximation. Biological and absorbable meshes may be left in situ after closure of the abdomen whilst non-absorbable meshes will usually need to be removed.</td>
</tr>
<tr>
<td>Mesh / sheet</td>
<td>First method used as temporary abdominal closure. The abdominal cavity is loosely packed and the fascial defect is covered by standard wound dressing only. No retraction of fascial edges is prevented.</td>
</tr>
<tr>
<td>Loose packing</td>
<td>The skin is closed over the fascial defect with towel clips or a running suture. Provides protection of underlying viscera but does not prevent retraction of fascial edges.</td>
</tr>
<tr>
<td>Skin only</td>
<td>A mesh or sheet with a sterilized zipper is sutured between the fascial edges. Prevents retraction of the abdominal wall and allows repeated access without the need of resuturing the mesh.</td>
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The use of V.A.C. in abdominal sepsis which is not related to trauma, has been less well established. There might be different reasons for the discrepancy in the fascial closure results between trauma patients and peritonitis patients. One reason is substantially higher age in abdominal sepsis, which was median 63 years in this series, compared with trauma series with a median age generally younger than 40 years. The lower age corresponds to less comorbidity, resulting in a higher potential for a rapid resolution of bowel edema.

Another important reason is the differences in time until primary closure is feasible. The main indication for abdominal V.A.C. system in trauma patients is abdominal compartment syndrome or a damage control situation with early relaparotomy and definitive repair. In contrast, patients with severe contamination associated with abdominal sepsis are likely to require repeated lavages. Ongoing intra-abdominal infection with repeated abdominal washouts prolongs the recovery and delays definite fascial closure. This results in lateral retraction of the fascial edges despite the negative pressure of the V.A.C. system. Primary closure is difficult if treatment with the open abdomen exceeds two weeks. It is advised that to prevent the retraction, an early closure of the fascia should be attempted, beginning at the cranial and caudal ends of the incision, even if ongoing contamination is present intra-abdominally.

Numerous debates on the clinical use and the cost-effectiveness of these different topical negative pressure systems compared with each other and with a standard wound therapy are recorded, and still are subjects of international consensus meetings and round tables. However negative pressure wound therapy has become widely adopted over the last 15 years and over 1000 peer reviewed publications are available describing its use. In the literature this type of treatment could be found under several names such as TNP therapy, negative pressure wound therapy (NPWT), VAC (vacuum-assisted closure), subatmospheric pressure dressing, vacuum sealing technique, vacuum compression therapy, microdeformational wound therapy, sealed surface wound suction, vacuum pack (abdominal wound dressing), gauze-based negative pressure wound therapy. Whatever name we chose to describe this method, the following mechanisms have been attributed to TNP therapy:

- creates a moist environment,
- reduces edema,
- increases local blood flow,
- stimulates angiogenesis and formation of granulation tissue,
- stimulates cell proliferation,
- reduces size and complexity of the wound,
- removes soluble healing inhibitors from the wound,
- Reduces bacterial load.

It is to be noted that some of these statements are purely based on expert opinion since no study has ever been undertaken.

**REPORT OF A CASE**

A 58 years old patient, BM, was admitted to our ward, after several laparotomies due to the distal and liver spreading of previously operated cancer of sigmoid colon cancer. Upon admittance the patient developed stercoral peritonitis, and was urgently operated. Another laparotomy revealed perforation of the necrotic segment of distal jejunum, due to the thrombosis of regional blood supply. A resection of this segment forming terminal jejunostomy was then performed.

Being subjected to several repeated laparotomies, with diffuse abdominal sepsis, this abdominal wall was almost impossible to reconstruct. Proximity of the jejunostomy to the laparotomy wound, clearly complicated, already disastrous situation. It did not take long before jejunostomy wound disrupted, and two wounds joined in one large complicated and infected area, impossible to manage. The only possible solution was to apply VAC therapy.

After isolating and hermetizing jejunostomy, which was luckily fixed in place with the underlying large omental flap, we were able to position polyethylene foam dressing...
over the paraffin saturated gauze. Placing the barrier over the entire abdomen, and over the stoma fixtures, we were able to establish 125 mmHg of negative pressure, and regular emptying of jejunostomy directly into bag.

We changed dressings daily, for the first few days and noticed exceptionally progress in the status of the abdominal wound. After a while, there were no reasons for daily redressing, but for one in three days. Significant signs of the wound shrinkage were noticeable after three weeks, and after four weeks we begin to make plans of definitive closure or possible reconstructive surgery, when the patient state started to deteriorate, and lethally ended with signs of multiple organ failure.

**CONCLUSION**

Although the treatment of this extremely severe patient ended tragically, it gave us an opportunity to apply VAC therapy as a last resort in such cases, and gain positive experience that could not be otherwise seen in everyday clinical practice.

**SUMMARY**

Upotreba Vakum Asistiranog Zatvaranja (VAC) abdomena svoju široku upotrebu pronašla je u tretmanu "Otvorenog trbuha", tehnike kod lečenja teških abdominalnih trauma, i kod ovih pacijenata se pokazala veoma efektna i sa visokim procentom uspešnih naknadnih rekonstrukcija fascije trbušnog zida. Uloga VAC tehnike kod pacijenata sa teškim difuznim peritonitom i dalje je predmet rasprava, pre svega jer se radi o ozbiljno ugroženoj heterogenoj grupi pacijenata. Vakum asistirano zatvaranje abdomena u pojedinim teškim septičkim stanjima otvorenog abdomena može biti i poslednji izbor hirurga.

Ključne reči: VAC, otvoren abdomen, abdominalna sepsa, infekcija, stoma

**REFERENCE**


