The Simplest Modified Vacuum Assisted Closure to Treat Chronic Wound : Serial Case Report

Danu Mahandaru, Rosadi Seswandhana
Yogyakarta, Indonesia.

Background: Among the current adjunctive treatment modalities available for the treatment of chronic wounds, vacuum-assisted closure therapy showed promising results. However, the VAC Therapy system is expensive, requires extensive amounts of product and needs a power source at all times. In this article, the authors introduce and review their experience with simplest modified vacuum assisted closure (smVAC) for treatment of chronic wound.

Methods: Three patients with chronic wound came to the plastic surgery division at Sardjito hospital in early 2010 and were treated using simplest modified vacuum assisted closure (smVAC). After the wound bed was ready, split thickness skin graft (STSG) were performed to close the wound and smVAC was used to assist the graft placement.

Results: All patients underwent successful healing and reported satisfaction with their results. There were no side effects from using this device, such as maceration, necrosis and bleeding.

Summary: Through the serial cases, the smVAC had shown to serve its function in providing adequate vacuum pressure for wounds. It is an alternative to the original vacuum assisted closure.

Keywords: chronic wound, vacuum assisted closure, split thickness skin graft, simplest modified vacuum assisted closure

Chronic wound poses an ongoing challenge for its management. It is a major source of morbidity, lead to considerable disability, and is associated with increased mortality. Therefore, it has a significant impact on public health and the expenditure of health care resources 1,2. Among the current adjunctive treatment modalities available for the treatment of chronic wounds, vacuum-assisted closure therapy has shown promising results. It is a new technique of management of wound based on the principle of application of controlled negative pressure 3,4,5. It is frequently recommended for use with chronic wounds, acute and traumatic wounds,

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flaps, grafts, and other non-sutured wounds such as dehisced incisions. The mechanism of this procedure is to reduce exudates and colonization of bacteria, stimulate angiogenesis, increase perfusion, and stimulate granulation tissue.\textsuperscript{6,7,8}

However, the VAC Therapy system has its disadvantages. It is expensive and requires extensive amounts of product and machinery, as well as functioning suction, and a power source at all times. In addition, the VAC Therapy system requires a trained and vigilant nursing staff.\textsuperscript{1,3} To overcome those problems, the idea to invent a modification of VAC system with simple, accessible, save, massively produced and cheap materials took place. The modification aimed to reach the same benefits as the original one. In some countries the VAC systems modification were conducted by using accessible materials in each country as well using the device for different kinds of wound.\textsuperscript{4,9} For example:

- Atlanta, 2001: Negative pressure dressings (by continuous wall suction) in treatment of hidradenitis suppurativa
- Japan, 2003: Topical negative pressure using a drainage pouch without foam dressing for the treatment of undermined pressure ulcers.
- Indonesia, 2005: A simple modified-VAC system for improving skin graft survival, treat chronic wound, etc.

**METHODS**

**MODIFICATION OF VACUUM ASSISTED CLOSURE**

The reference for modification was the experience on modified vacuum assisted closure in Jakarta 2005. Simplification of the device was conducted by changing the manometer indicator with the infused balloon. In vitro test was done using 20 Otsuka blood transfusion set (elastic ball type) as shown in Figure 1.

From the test above, the smVAC cannot quantify in exact the strength of vacuum pressure applied (with an estimated range between 110-390 mmHg). The negative pressure recommended for chronic ulcer is 125 mmHg. The pressure indicator used for this device was if one balloon was deformed the estimated pressure was ± 110 mmHg. A model

![Figure 1](image1.png)

**Figure 1.** (Left) The pressure when one of the balloon of transfusion set deformed (110mmHg); (Right) The pressure when all of the balloons of transfusion set collapsed (390mmHg)
of the device is shown in Figure 2 and the specification listed in Table 1.

**CASE 1**

The first case was a male, 52 years old with a history of 25 years chronic wound at the lateral side of the right ankle region. The wound had bad granulation tissue and necrotic tissue. First the wound was debrided, then smVAC was applied at the wound. After 7 days, the smVAC was released, and the wound had resulting good granulation tissue. Split thickness skin graft used to cover the wound and the smVAC was used to assist graft placement. Fifth day later, the smVAC was released and the STSG adhere completely to the wound bed. On the tenth day, the graft had successfully covered the wound. (Figure 3)

**CASE 2**

The second case was a male, 24 years old with chronic wound at the posterior side of the left ankle region. The wound was exudative, with inadequate granulation tissue and exposed sutures at the Achilles tendon. Debridement and refreshment of the wound by marginal excision were done. Afterwards, the smVAC was applied to the wound. At the twelfth day, the smVAC was released and the wound already had good granulation tissue and ready to be covered with skin graft. Split thickness skin graft was used with the smVAC to assist graft placement. Seventh day after STSG, vacuum was released and the graft took 100% in process. Finally, at the 13th day after STSG, the graft successfully covered the wound. (Figure 4)

**CASE 3**

The third case is 28 years old male, with 4 months multiple chronic wound at the left lower leg region. There were two wounds that had necrotic tissue and boundary with unhealthy skin. First the patient underwent debridement and refreshment of the wound edges. Then the smVAC was applied at the wound. At the fifth day, the vacuum was released and the wound revealed good

<table>
<thead>
<tr>
<th>Specification</th>
<th>Alternative</th>
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<tbody>
<tr>
<td>Negative Pressure Supply Unit</td>
<td>Disposable Syringe 50 ml with three way infusion set</td>
</tr>
<tr>
<td>Disposable unit</td>
<td>100 cc closed rubber-sealed vacuum bottle</td>
</tr>
<tr>
<td>Canister</td>
<td>Sterile gauge</td>
</tr>
<tr>
<td>Dressing</td>
<td>Grass tulle</td>
</tr>
<tr>
<td>Tubing</td>
<td>Transparant Adhesive-Occlusive Dressing (tegaderm®, opsite®)</td>
</tr>
<tr>
<td>Connector</td>
<td>Otsuka blood transfusion set (elastic ball type)</td>
</tr>
</tbody>
</table>
granulation tissue and ready to be covered by graft. Then split thickness skin graft were performed and smVAC used again to assist the graft placement. Ten days after STSG the vacuum was released and the graft took 100% in process (Figure 5).
RESULT

All patients underwent successful healing and reported satisfaction with their results. There were no side effects from using this device, such as maceration, necrosis or bleeding. Patient did not feel discomfort or pain in using this device. Patients’ characteristics are shown on Table 2.

Table 2. Characteristic of the patients, result and side effect of the treatment

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age</th>
<th>Diagnosis</th>
<th>Result</th>
<th>Time</th>
<th>Pain/discomfort</th>
<th>Side Effect</th>
<th>Satisfy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>52 y.o</td>
<td>Chronic ulcer at right ankle region</td>
<td>Full healing</td>
<td>12 days</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>24 y.o</td>
<td>Chronic ulcer at posterior side of ankle region (achilles)</td>
<td>Full healing</td>
<td>19 days</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>28 y.o</td>
<td>Multiple chronic ulcer at left lower leg</td>
<td>Full healing</td>
<td>15 days</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

DISCUSSION

The use of a vacuum system (Vacuum-Assisted Closure, USA) to help wound healing was introduced in 1997 by Argenta et al. Negative pressure seems to promote drainage of excessive fluids from the wound bed and interstitial space, reducing bacterial population and edema, enhancing local blood flow and

Figure 4. (Upper left and right) Male 28 year old with 4 months multiple chronic wound at the left lower leg region. There were two wounds that had necrotic tissue and surrounded by unhealthy skin, (Middle left) application of simplest modified vacuum-assisted closure (smVAC), (Middle right) 5 days after used the vacuum (the wound is ready to be closed), (Lower left and right) 4 weeks after treatment. The vacuum (the wound is ready to be closed), (Lower left and right) 4 weeks after treatment.
granulation tissue formation. Other effect of vacuum closure is to pull of the wound borders to the center, reducing the wound diameters due to retraction. Surgeons believe that the treatment of difficult wounds should be primarily surgical, and the VAC system was reported to accelerate the preparation of the wound to definitive surgical closure. In other words, it improves the local conditions in patients who are waiting a better clinical situation to be submitted to surgical procedures. The pressure is extremely important.

With these concepts in mind, we introduced in our service, the simplest modified vacuum assisted closure. The system was used to treat 3 cases of difficult wounds, thus preparing them to definitive surgical closure. The vacuum treatment aimed also to improve the take of skin grafts. We are conducting a clinical trial on this subject. However, as our first impression was quite positive, and we decided to report this initial experience.

**SUMMARY**

Through our serial cases, the smVAC cannot quantify in exact the strength of vaccum pressure applied (we can only estimate a range between 110-390 mmHg) but it has shown to serve its function in providing adequate vacuum pressure for wounds. The benefits of our modified VAC is that it is cheaper and can be constructed using simple clinical devices. This device can be used as an alternative device, if we could not use the original ones.

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**REFERENCES**

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