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Clinical vignette

Wall vacuum-assisted closure technique for a complex enteroatmospheric fistula: report of a case

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Background: An enteroatmospheric fistula (EAF) is a devastating complication of abdominal surgery. EAF wound care is uniformly problematic and burdensome because the fistula effluent is difficult to contain, causing several abdominal skin problems.
Objectives: To report the case of a complex EAF in a patient in whom conventional wound care techniques failed to contain the fistula.
Methods: We reviewed the patient's medical records and the novel wound care technique used to contain the fistula.
Results: We report the use of a modified vacuum-assisted closure (VAC) technique, the "Wall VAC", for the wound care of a patient with a complex EAF having large and multiple fistula openings following multiple abdominal operations. The Wall VAC technique consists of (1) leveling the skin surrounding the EAF wound, (2) creating the Wall VAC using a rectangular-shaped VAC sponge with 2 suction systems, and (3) sealing the system with a plastic bag and incise drape. By using this technique, the fistula effluent was effectively contained and the abdominal skin was well protected. The system changed every 3 to 4 days.
Conclusions: Our modified VAC technique, the "Wall VAC", is simple and effective in containing a large volume (3,000 to 4,000 mL) of fistula effluent and protecting the abdominal skin in a patient with a complex EAF. We recommend this particular technique as an alternative method for managing a complex EAF.

Keywords: Enteroatmospheric fistula, negative pressure wound therapy, vacuum-assisted closure, wall VAC

Enteroatmospheric fistula (EAF) is one of the most devastating complications of abdominal surgery and an open abdomen because it causes several problems including fluid electrolyte imbalances, nutritional depletion, infection, and wound care problems [1-4]. The intestinal content coming out from the EAF is usually difficult to contain, especially if the fistula is proximal and of high output, resulting in multiple skin problems (irritation, maceration, erosion, and infection) [2-4]. Multiple EAF wound care techniques using vacuum-assisted closure (VAC) have been proposed; however, there is no single universal technique that can be applied to every EAF because each fistula is different [3]. Hence, the wound care of EAF should be individualized for each patient. We report a novel VAC technique used to contain the fistula effluent and protect skin in a patient with a complex EAF.

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Case report

A 53-year-old male patient presented with abdominal pain and mass. A diagnosis of a malignant gastrointestinal stromal tumor of the stomach with peritoneal seeding was made, and the patient underwent exploratory laparotomy with wedge gastrectomy and tumor debulking in 2006. He subsequently received targeted therapy (imatinib). However, the tumor was recurrent, causing intestinal obstruction requiring a right colectomy in August 2013 and tumor debulking in April 2015. Subsequently, the patient developed an enterocutaneous fistula through the midline surgical wound and failed nonoperative management. Therefore, he underwent surgery again for the fistula closure in July 2015. Nevertheless, there was dense adhesion intraperitoneally and multiple enterotomies were encountered during the lysis of adhesion. Intestinal repair and small bowel resection were attempted. Unfortunately, the intestinal content leaked out through the midline laparotomy wound causing wound breakdown and the EAF was revealed on postoperative day 14. A VAC was applied to the EAF wound, but could not contain the fistula effluent

well. An ostomy bag placing directly on the fistula openings over the cut hole of the VAC sponge (fistula VAC technique) also failed to contain the fistula effluent because the fistula output was very high (3,000–4,000 ml of effluent per day), the patient had multiple large fistula openings, and the abdominal skin surrounding the EAF was not even (**Figure 1**).

Therefore, a modified VAC technique (the "Wall VAC") was devised to suit the patient's EAF wound. Three principle steps were applied, including:

1. Leveling the skin surrounding the EAF wound. We used a layer of hydrocolloid dressing (DuoDERM, ConvaTec) to protect the skin from fistula effluent (**Figure 2A**) and another layer of skin barrier wafer (Stomahesive, ConvaTec) for additional skin protection and skin leveling (**Figure 2B**). Each layer was reinforced with an incise drape (Ioban, 3M).
2. Creating the Wall VAC using a rectangular-shaped VAC sponge. We used 2 suction systems, a nasogastric tube embedded in the sponge and a larger tube drain with multiple side holes placed medially to the wall (**Figure 3**).
3. Sealing the system. We put the Wall VAC sponge in a plastic bag with a cut window in the bag's posterior surface and applied the whole system to the EAF wound on top of the skin barrier (**Figure 4A**). The edges of the plastic bag were sealed with an incise drape to create a closed system and the tubes were connected to wall suction with a negative pressure of –80 to –100 mmHg (**Figure 4B**).

By using the Wall VAC technique, we were able to contain the fistula effluent (3,000 to 4,000 mL per day) effectively, with the system changed every 3 to 4 days. The skin surrounding the EAF wound was well protected and the patient could resume a liquid diet. The patient had been given parenteral nutrition to help maintain is nutritional status, and so he had stable body weight and serum albumin (>3.0 g/dL) throughout admission. However, because the tumor had progressed and become unresectable, definitive surgery to close the EAF was not attempted and the treatment plan was supportive care. The patient suffered from multiple episodes of catheter-related blood stream infection, and subsequently developed an acute kidney injury and died 19 months postoperatively.

The patient's family provided written consent for publication of this case report after earlier consent for medical instruction from the patient.

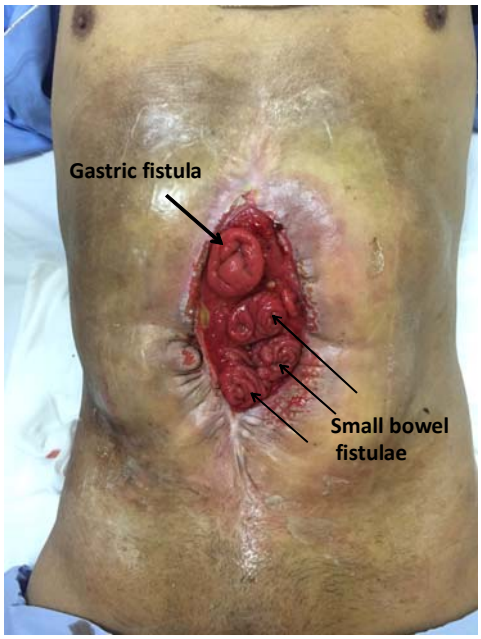

Figure 1. An enteroatmospheric fistula in the present patient, the multiple intestinal openings are demonstrated (arrows). Clinical photograph with consent of the patient and permission from the patient's family for publication.

Figure 2. The Wall VAC technique: leveling the skin surrounding the enteroatmospheric fistula wound. **A.** A layer of hydrocolloid dressing (DuoDERM, ConvaTec) was used to protect the skin from fistula effluent. **B.** Another layer of skin barrier wafer (Stomahesive, ConvaTec) was applied for additional skin protection and skin leveling. Each layer was reinforced with an incise drape (Ioban, 3M). Clinical photographs with consent of the patient and permission from the patient's family for publication.

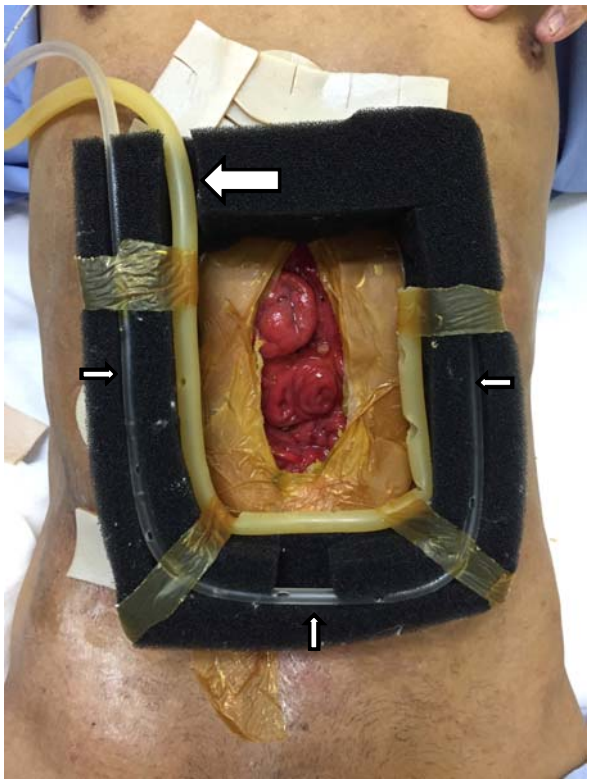

Figure 3. The Wall VAC technique: creating the "Wall VAC" using a rectangular-shaped VAC sponge. Two suction systems were used, a nasogastric tube embedded in the sponge (small arrows) and a larger tube drain with multiple side holes placed medially to the wall (a large arrow). Clinical photographs with consent of the patient and permission from the patient's family for publication.

Figure 4. The Wall VAC technique: sealing the system. **A.** A Wall VAC sponge was put in a plastic bag with a cut window in the bag's posterior surface (dashed rectangle) and the whole system was applied to the enteroatmospheric fistula wound on top of the skin barrier. **B.** The edges of the plastic bag were sealed with an incise drape (Ioban, 3M) to create a closed system and the tubes were connected to wall suction with a negative pressure of –80 to –100 mmHg. Clinical photographs with consent of the patient and permission from the patient's family for publication.

Discussion

EAF is one of the most serious complications occurring in patients with an open abdomen. The reported incidence of EAF in the open abdomen ranges from 1.5% to 75% [2, 5], and was 12% in our experience [6]. EAF carries with it high mortality rates (19%–67%); the causes of death include fluid and electrolyte disturbances, protein loss, nutritional depletion, and sepsis [2-6]. EAF wound care is a very difficult and challenging problem. Although the application of negative pressure wound therapy using various VAC techniques helps contain the fistula effluent and promotes wound healing in EAF patients, none of these techniques can be universally applied to every EAF. Direct application of a VAC system over an EAF wound appears to be the simplest method of EAF wound care; however, effluent diversion is not quite effective and this method carries a risk of new fistula formation [3, 7].

Definitive treatment for EAF in the majority of patients is surgery to lyse the intra-abdominal adhesion, to resect the fistulous part with possible anastomosis, and to perform definitive abdominal closure [1, 2, 5]. Appropriate timing of surgery in patients with EAF is at least 4 to 6 months after the diagnosis to facilitate surgery and optimize the patient's condition [1, 2, 5]. Although the spontaneous closure of some small fistulae with VAC techniques have been reported; this spontaneous closure never occurs for a large EAF with the mucosa protruding, as seen in our patient [2-4].

Multiple techniques have been proposed to help isolate the opening of a fistula from the surrounding granulated open abdominal wound; e.g. split-thickness skin grafting on the granulated wound, fistula VAC (using an ostomy bag), tube VAC (using a Malecot catheter), and nipple diversion (using a baby bottle nipple) [2-4, 8]. These fistula isolation techniques are suitable for an EAF with a small fistula opening and a surrounding granulated open abdominal wound (for the VAC sponge to be applied onto). Occluding a small EAF opening using a silicon plug in conjunction with VAC has been reported to achieve spontaneous EAF closure [9]. However, none of these techniques could be used effectively in the present patient because of the size and number of the fistula openings, the surrounding skin condition, and the substantial amount of the fistula effluent output. Therefore, we modified

the VAC technique to make it suitable for the present patient, i.e. by constructing a wall of sponge surrounding the large EAF instead of putting a sponge or bag directly onto the EAF.

We found that the "Wall VAC" technique was very effective in containing the large amount of fistula effluent from multiple fistula openings because the wall of sponge surrounding the EAF serves as both a container and a drainage system. The size and shape of the sponge wall can be tailored to fit any large EAF wound. A larger tube drain placed medially to the wall provides additional drainage of thick fistula effluent and small food particles. The Wall VAC is not difficult to assemble and is relatively inexpensive (around 2,000 THB or 60 USD per set). However, applying the Wall VAC to the present patient required 30 to 45 minutes to complete the entire process (**Figures 2–4**). Because of the lack of a series of other cases or clinical trial, the authors could not compare the effectiveness of the "Wall VAC" technique to other methods even though it worked well in the present patient. A case series or clinical trial to confirm the effectiveness of the technique appears warranted.

Conclusion

The "Wall VAC" technique provides adequate effluent containment and skin protection to a patient with a complex EAF with large and multiple fistula openings. The authors recommend this particular technique as an alternative method for managing a complex EAF.

Author contributions

All authors contributed substantially to the conception and design of the study, and acquisition, analysis and interpretation of data. All authors were involved in drafting the manuscript and its critical revision. All authors approved the final version of the manuscript submitted for publication and take responsibility for the statements in the article.

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Conflict of interest

No authors declare any conflict of interest related to this case.

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