Application of Negative-pressure Wound Therapy with Instillation and Dwelling Using a New Foam Dressing (V.A.C. VERAFLÒ CLEANSE CHOICE): Initial Experience in Japan

Michika Fukui, MD, Natsuko Kakudo, PhD, Yuki Matsuoka, MD, Natsumi Fujiwara MD, and Kenji Kusumoto, PhD

ABSTRACT

Introduction: Negative-pressure wound therapy (NPWT) with instillation and dwelling (NPWTi-d) system can be used to treat infected wounds. In 2017, a new reticulated open cell foam dressing (ROCF-CC) for NPWTi-d was launched. The feature of ROCF-CC is that the contact layer contains holes. It allows viscous exudate and infected materials to be removed. We report for the first time the application of NPWT-i-d with ROCF-CC in Japan.

Methods: Four patients who were admitted to our hospital between August and December 2019 were indicated for NPWTi-d with ROCF-CC. The causes of the patients’ wounds, dosage of saline, saline dwell time, degree and cycle frequency of negative pressure, frequency of foam dressing changes, and duration of NPWTi-d were examined.

Results: The treated wounds consisted of necrotizing fasciitis, diabetic skin ulcer, postoperative wound, and ulcer caused by hematoma. A total of 10–100 mL of normal saline was instilled. The dwell time ranged from 5 to 10 min. The cycle frequency of negative pressure ranged from 2 to 3.5 h, and the level was set at –125 mmHg. Dressing changes were conducted every 2–4 days. Granulation tissue formed without infections developing. Since the necrotic tissue was removable due to ROCF-CC, debridement was easy. The problems were pain and maceration.

Conclusion: We found that using NPWTi-d with ROCF-CC enabled the removal of necrotic tissue and viscous wound exudate. It allows debridement to be performed easily and safely without affecting the normal tissue and hastens granulation tissue formation.

Key words: debridement, negative-pressure wound therapy with instillation and dwelling, V.A.C. VERAFLÒ CLEANSE CHOICE

Introduction

Negative-pressure wound therapy (NPWT) is frequently used to debride chronic wounds and accelerate granulation tissue formation in wound beds. Recently, an automated NPWT with instillation and dwelling (NPWTi-d) system (V.A.C. ULTA™ Therapy System, KCI) has been introduced for treating acute and chronic wounds. In NPWTi-d, a solution is instilled into the wound bed, and the wound bed is cleansed intermittently. Thus, NPWTi-d can be used to treat infected wounds1. NPWTi-d has been covered by the public health insurance system in Japan since 2017.

In 2017, a new reticulated open cell foam dressing (ROCF-CC) for NPWTi-d (V.A.C. VERAFLÒ CLEANSE™ CHOICE™, KCI) was launched in the USA. The main beneficial feature of ROCF-CC is that it allows viscous exudate and infected materials to be removed when the dressing is changed. ROCF-CC can be used at an early stage for wound therapy even if the necrotic tissue remains. It is extremely important for wound treatment. Since 2019, this new type of foam dressing has been covered by the public health insurance system in Japan.

We firstly report the application of NPWT-i-d with ROCF-CC in Japan.

Method

Four patients who were admitted to our hospital between August and December 2019 were indicated for NPWTi-d with ROCF-CC. The ROCF-CC consisted of two layers of foam
dressing. The contact layer contained holes (diameter, 1 cm), which were spaced 0.5 cm apart. The other layer (two types of foams with different thickness types, 0.8 and 1.6 cm), which was placed over the contact layer, did not contain holes (Fig. 1a). The contact layer containing holes was placed on the wound bed, and the foam layer without holes was placed over the contact layer (Fig. 1b). When the wound bed was large and the foam contact layer was not big enough to cover it, we applied the foam to the wound pockets and/or deep parts of the wound bed. Normal saline was instilled in all cases since it is the only substance covered by the Japanese health insurance system. The dosage of saline was chosen so that it filled one-half to one-third of the wound bed. The dwell time was determined based on the amount of necrotic tissue. The frequency of wound bed cleansing was basically 3–3.5 h. The negative pressure level was set at –125 mmHg. Patients with infected wounds were first treated with intravenous antibiotics, and then, the wound was surgically debrided. Moreover, wound irrigation and topical ointment application were performed daily. After any symptoms of infection or inflammation improved, NPWTi-d with ROCF-CC was started.

The essential items for managing NPWTi-d, causes of the patients’ wounds, dosage of saline, saline dwell time, degree and cycle frequency of negative pressure, frequency of foam dressing changes, and duration of NPWTi-d were examined.

The treated wounds consisted of necrotizing fasciitis, diabetic skin ulcer, postoperative wound, and ulcer caused by a hematoma that arose after hemodialysis access. A total of 10–100 mL of normal saline was instilled into the wound bed in each case. The dwell time ranged from 5 to 10 min. The cycle frequency of negative pressure ranged from 2 to 3.5 h, and the negative pressure level was set at –125 mmHg. Dressing changes were conducted every 2–4 days.

Results

Granulation tissue formed without infections developing in all cases. A part of the necrotic tissue attached with the contact layer was removed when we took the contact layer off. Moreover, since the necrotic tissue was removable through the holes, debridement with cupped forceps could be easily performed. After NPWTi-d, three patients underwent skin grafts, and one was cured with ointment. The patient with the postoperative wound experienced pain when the foam dressing was changed. The patient who developed an ulcer caused by a diabetic skin experienced maceration of the periwound skin while undergoing NPWTi-d with ROCF-CC (Table 1).

Case 1

A 66-year-old male patient was hospitalized for necrotizing fasciitis of the back due to an infection of a pressure sore and enhanced inflammatory response (Fig. 2a). Computed tomography showed the presence of gas in the soft tissue of his back (Fig. 2b). On the same day, he was treated with intravenous antibiotics and underwent debridement in the operation room. As his inflammation was ameliorated, we started NPWTi-d with ROCF-CC at 12 postoperative days (Fig. 2c). A foam dressing with holes was cut to an appropriate size and inserted into the wound pockets and deep part of the wound. It was then covered with a foam dressing without holes (Figs. 2d and 2e). When the foam dressing was first changed, we found that the holes in the bottom layer were filled with columns of granulation tissue, the tops of which were covered with fibrin. Furthermore, the wound bed exhibited several elevated...
columns of granulation tissue that we called “granulo-columns” (Fig. 2f). Necrotic tissue accumulated on the tops of the granulo-columns and was easily removed. The peeled foam was sticky with thin necrotic tissue. NPWTi-d with ROCF-CC was conducted for 3 weeks (Fig. 2g). Good granulation tissue was noted, and no pockets were observed. Skin grafting was subsequently performed (Fig. 2h).

Case 2

A 74-year-old male patient was diagnosed with squamous cell carcinoma of the buttock arising from chronic pyoderma (Fig. 3a). The tumor was excised together with a 2-cm surgical margin and the muscle fascia at the base of the tumor (Fig. 3b). Histological examination demonstrated that the surgical margins were tumor-free, and we started NPWTi-d with ROCF-CC on postoperative day 21 (Fig. 3c). The edema affecting the wound bed improved, and the amount of granulation tissue increased rapidly (Fig. 3d). However, the patient experienced unbearable pain when the foam dressing was changed. Although we placed a cushioning material (silicone-faced wound dressing mesh, ALCARE) between the wound bed and part of the foam dressing containing holes, the cushioning material stuck to the wound bed, and removing it was problematic. We discontinued the NPWTi-d with ROCF-CC after 8 days and performed skin grafting (Figs. 3e and 3f).

Case 3

A 70-year-old male patient was admitted with an ulcer on his right groin, which had been caused by a hematoma that arose after hemodialysis access. The wound had a pocket that was 9 cm deep (Fig. 4a). Placing a layer of foam dressing containing holes into the deep pocket on its own would have been problematic because its removal would have been hindered by the granulo-columns adhering to the wall of the wound. Thus, we placed the layer of foam dressing containing holes on the wound bed and then covered it with a layer of foam dressing without holes (Figs. 4b, 4c, and 4d). The depth of the pocket decreased to 7 cm after 1 week (Figs. 4e and 4f) and 2 cm after 3 weeks (Fig. 4g). We subsequently performed skin grafting.

Case 4

A 72-year-old male patient with diabetes had an infected callous ulcer on his left sole (Fig. 5a). It was accompanied by osteomyelitis of the left second metatarsal bone (Fig. 5b). We performed surgical debridement in the operation room and removed the necrotic tissue from the region extending from the second metatarsal bone to the distal phalanx (Fig. 5c). NPWTi-d was started on postoperative day 3 (Figs. 5d and 5e). As foam dressing containing holes would have been difficult to remove from the narrow and deep wound bed, we cut some of the regions between the holes before applying the foam dressing (Fig. 5f). After 1 week, the exposed bone in the wound bed had been covered with granulation tissue (Fig. 5g). NPWTi-d with ROCF-CC was conducted for 3 weeks, and the size of the wound bed reduced (Fig. 5f). The wound was subsequently closed with ointment therapy alone.

Discussion

ROCF-CC is a new and unique type of foam dressing, which consists of a combination of mesh-like foam dressing containing holes and foam dressing without holes. Its greatest feature is that it makes it possible to remove viscous exudate and infected materials. In a study of ROCF-CC, Téot et al. reported that the amount of the wound surface that contained black necrotic tissue was reduced to <10% in 18/21 (85.7%) cases and the amount of the wound surface that contained yellow fibrinous sloughing was also reduced to <10% in 15/21 (71.4%) cases. Similarly, Obst et al. reported that the use of NPWTi-d with ROCF-CC helped to solubilize and remove thick wound exudate and nonviable tissue. This effect is related to the shape of ROCF-CC, which causes granulation tissue to form “granulo-columns” in the holes in the dressing. We confirmed that granulo-columns had formed at the bottom of the wound bed when we changed the foam dressings. Black and yellow fibrinous tissue usually accumulated at the tops of
Fig. 2. Case 1. A 66-year-old male, with necrotizing fasciitis of the back.

a: First time visit. b: CT showed gas of his back soft-tissue. (yellow arrows)
c: Twelve days after surgical debridement.
d: Dressing foam with holes was placed at pocket and deep wound bed.
e: Dressing foam without holes covers all.
f: Three days after start of NPWTi-d with ROCF-CC. Note necrotic tissue at the top of granulo-column. (blue arrows)
g: Twenty-one days after start of NPWTi-d with ROCF-CC. Necrotic tissue was removed by NPWTi-d with ROCF-CC.
h: Wound was recovered using a mesh skin graft.
Fig. 3. Case 2. A 74-year-old male, squamous cell carcinoma of buttock.

a: First time visit.
b: Tumor excision with a 2-cm surgical safe margin and muscle fascia in the base
c: NPWTi-d with ROCF-CC started 21 days after operation.
d: Three days after start of NPWTi-d with ROCF-CC. No necrotic tissue at granulo-columns.
e: Eight days after start of NPWTi-d with ROCF-CC. Flat and good granulation was shown.
f: Wound recovered using a mesh skin grafting.
Fig. 4. Case 3. A 70-year-old, with ulcer of the right groin arisen from hematoma.

a: A pocket 9 cm in the depth was observed.
b, c, d: We put dressing foam with holes in pocket and cover it with dressing foam without holes.
e, f: Seven days after start of NPWTi-d with ROCF-CC. Pocket decreased to 7 cm.
g: Twenty-one days after start of NPWTi-d with ROCF-CC. Pocket decreased to 2 cm.
Fig. 5. Case 4. A 72-year-old male, with diabetic foot.

a: First visit, infectious callous ulcer of left sole was observed.
b: MRI showed osteomyelitis of the left second metatarsal bone.
c: Removal of the necrotic tissue from second metatarsal bone to the distal phalanx after debridement.
d, e, f: NPWTi-d with ROCF-CC started the day 3 after surgical debridement. The dressing foam with cutting between holes was inserted.
g: Seven days after start of NPWTi-d with ROCF-CC.
h: Twenty-one days after start of NPWTi-d with ROCF-CC.
the granulo-columns⁴, as described in case 1. In addition, the necrotic tissue was easily removed from the granulo-columns attached to the ROCF-CC. Debridement of the wound bed also became easier and involved less bleeding and pain.

Debridement is an important technique for inducing the proliferation phase after the inflammatory phase in wound beds. There are five types of debridement (autolytic debridement, biological debridement, enzymatic debridement, surgical debridement with sharp instruments, and mechanical debridement)⁵. In our treatment method, surgical, autolytic, and mechanical debridement procedures are usually performed. Surgical debridement is an effective way of removing necrotic tissue. However, it is occasionally not chosen due to the patient’s poor general condition; the risk of excessive damage, which can result in delayed healing; or the fact that the presence of an infection or necrotic tissue after debridement can delay the commencement of NPWTi-d. In cases with such complications, surgical debridement may not be appropriate. On the other hand, mild debridement with ROCF-CC does not damage the healthy parts of wounds nor require special techniques because it allows necrotic tissue to be detached easily. Most surgical debridement procedures are performed in an operation room, and they are associated with a risk of bleeding and require anesthesia. Mild debridement with ROCF-CC can reduce the need for debridement in the operation room. McElroy reported that 12 of 14 patients who were treated with NPWTi-d with ROCF-CC did not need to return to the operation room for further debridement⁶. Moreover, debridement with ROCF-CC enables the early initiation of NPWTi-d in complex cases⁷, which helps to reduce the duration of therapy and treatment costs⁸. It has not been determined what kinds of necrotic tissue NPWTi-d with ROCF-CC is most effective against or how much residual necrotic tissue can be present at the start of NPWTi-d with ROCF-CC.

The use of ROCF-CC may cause granulation tissue proliferation to occur earlier than is seen after the use of conventional foam dressings without holes. Téot et al. reported that 95.2% of cases displayed rapid granulation tissue formation under the portion of the foam that was in direct contact with the wound bed⁹. It is considered that the shape of ROCF-CC produces mechanical stress, which increases granulation tissue formation⁹.

One of the limitations of using ROCF-CC is that the granulo-columns that form in pockets or deep wounds can hinder the changing of foam dressings. Thus, it will be necessary to improve the placement of foam dressings with holes, as was demonstrated in cases 3 and 4. In case 4, we made it easier to change the foam dressing by cutting the regions between the holes.

Other problems associated with the use of ROCF-CC include the maceration of the periwound skin and pain when the foam dressing is changed. The application of waterproof film around the wound bed and injection of saline are effective treatments for maceration⁹. Pain can be reduced by soaking the wound in saline or administering lidocaine before removing the foam dressing⁹.

The use of NPWTi-d with ROCF-CC will be expanded in Japan in the near future, and to take advantage of our experiences in the reported cases, longer follow-up and further examinations will be necessary.

**Conclusion**

We found that using NPWTi-d with ROCF-CC enabled the removal of necrotic tissue and viscous wound exudate. This new type of foam dressing can be used at an early stage, even if the necrotic tissue remains. Furthermore, it allows debridement to be performed easily and safely without affecting the normal tissue and hastens granulation tissue formation.

**Acknowledgment**

We wish to thank the advice and expertise of Mr. Miyagaki.

**Conflicts of interest**

None.

**References**

1) Matsunaga H, Ohura N, Sakisaka M, et al: The efficacy of negative pressure wound therapy with periodic automated instillation and dwell time for patients with infectious wounds. *J Jpn P.R.S.* 2019; 50: 877-85.
2) Téot L, Boissiere F, Fluieraru S: Novel foam dressing using negative pressure wound therapy with instillation to remove thick exudate. *Int Wound J* 2017; 14: 842-8.
3) Obst MA, Harrigan J, Wodash A, Bjurstrom S: Early-stage management of complex wounds using negative pressure wound therapy with instillation and a dressing with through holes. *Wounds* 2019; 31: E33-E36.
4) Kim PJ, Applewhite A, Dardano AN, et al: Use of a novel foam dressing with negative pressure wound therapy and instillation: recommendations and clinical experience. *Wounds* 2018; 30 (Suppl): S1-S17.
5) Terashi H: Debridement. *Jpn J Vasc Surg* 2018; 27: 77-9.
6) McElroy EF: Use of negative pressure wound therapy with instillation and a reticulated open cell foam dressing with through holes in the acute care setting. *Int Wound J* 2019; 16: 781-7.
7) Ben-Nakhi ME, Eltayeb HI: First Middle East experience with novel foam dressing together with negative pressure wound therapy and instillation. *Cureus* 2018; 10: e3415.
8) Fernandez LG, Ellman C, Jackson P: Initial experience using a novel reticulated open cell foam dressing with through holes during negative pressure wound therapy with instillation for
management of pressure ulcers. *J Trauma Treat* 2017; 6: 5.
9) Christensen TJ, Thorum T, Kubiak EN: Lidocaine analgesia for removal of wound vacuum-assisted closure dressings: a randomized double-blinded placebo-controlled trial. *J Orthop Trauma* 2013; 27: 107-12.