INTERNATIONAL **CASE STUDIES**

Retrospective case series: Wounds treated with 3M™ Veraflo™ Therapy

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WOUNDS | INTERNATIONAL

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Introduction

Box 1. Suitable wound types (adapted from Wounds Asia, 2022)

- Traumatic wounds
- Diabetic wounds
- Venous leg ulcers
- Pressure injuries/ ulcers
- Dehisced wounds
- Wounds with exposed intact bone
- Wounds with treated, underlying osteomyelitis
- Infected or contaminated wounds in the presence of orthopaedic fixation hardware
- Full-thickness burns after excision
- Wounds resulting from evacuation of a haematoma and when haemostasis is achieved
- Wounds that are a bridge between staged/delayed amputation.

Box 2. Veraflo Therapy goals (Wounds International, 2021)

- Granulation tissue formation
  - Promote granulation tissue formation
  - Decrease wound volume
  - Cover exposed structures.
- Wound cleansing
  - Remove slough and infectious materials
  - Reduce risk of compromised wound healing due to contamination or bioburden
  - Decrease viscosity and volume of exudate.

3M™ Veraflo™ Therapy provides clinicians with a tool for managing patients and wounds with greater complexity [Box 1]. It combines the benefits of standard negative pressure wound therapy (NPWT; 3M™ V.A.C.® Therapy) with automated, user-determined delivery of topical wound treatment solutions that dwell in the wound to help dilute and solubilise infectious materials, slough and exudate. These instillation cycles, followed by periods of negative pressure, allow wounds to be repetitively cleansed without the need for daily dressing removal.

Once solubilised, wound debris and infectious materials are removed under negative pressure with the aim of promoting granulation tissue formation and perfusion to prepare the wound for closure. Goals for using NPWT with instillation and dwell time (NPWTi-d), also known as Veraflo Therapy, are varied [Box 2].

Dressing considerations

Veraflo Therapy uses dressings specifically designed for instillation therapy that provide improved fluid distribution within, and removal from, the wound bed. Dressing selection can be determined by wound type [Table 1]. Dressing changes of three times weekly (every 48–72 hours) is recommended as a minimum.

Table 1. Dressing selection and description based on wound type (Wounds International, 2021; Wounds Asia, 2022)

Dressing	Description	Wound type
3M™ V.A.C.® Veraflo™ Dressing	To be used when the wound needs a combination of granulation tissue formation and cleansing	Open wounds, including wounds with shallow undermining or tunnel areas where the distal aspect is visible
3M™ V.A.C.® Veraflo™ Large Dressing	To be used to facilitate the removal of infectious material and other wound bioburden and promote granulation tissue formation in large wounds	Large open wounds, including wounds with shallow undermining or tunnel areas where the distal aspect is visible
3M™ V.A.C.® Veraflo Therapy Cleanse™ Dressing	To be used when granulation tissue formation is not a primary treatment goal	Cavity wound or wounds with complex geometries including explored tunnels or undermining where the distal aspect is not visible
3M™ V.A.C.® Veraflo Therapy Cleanse Choice™ Dressing	To be used to cleanse the wound, promote wound healing and facilitate the removal of infectious materials and when complete surgical debridement of a large, complex wound is not possible.	Contaminated wounds or wounds with thick fibrinous exudate, slough, infectious material and other wound bioburden.

Solution considerations

There are a range of recommended compatible solutions to use for instillation such as normal saline, hypochlorite-based solutions (e.g. hypochlorous acid solution or sodium hypochlorite solution [dilute Dakin's solution 0.125% or quarter strength]), acetic acid solution (0.25–1%) and polyhexamethylene biguanide (0.1%) and betaine (0.1%) (Kim et al, 2020; Wounds Asia, 2022).

Hypochlorite-based solutions, such as hypochlorous acid solution or sodium hypochlorite solution, are recommended as the initial topical solution for wounds showing clinical signs of infection, followed by saline instillation after 24 to 48 hours. This should be in conjunction with appropriate systemic antibiotic therapy, and the decision to switch to saline should be based on ongoing patient and wound assessments.

Topical antiseptic solutions are also recommended for instillation in certain cases, such as the presence of acute infection, high levels of bacteria colonisation or when treating wounds with orthopaedic fixation hardware (Kim et al, 2020).

Therapy setting considerations

Commonly used therapy settings include a therapy time setting of 2 to 3 hours for V.A.C.® Veraflo Dressing and 2 to 2.5 hours for V.A.C.® Veraflo Cleanse Choice Dressing. An appropriate dwell time setting of 10 minutes with saline (or other compatible) solutions and a pressure setting of -125mmHg is also commonly used (Kim et al, 2020) with V.A.C.® Veraflo Dressing, unless non-viable tissue is present, and V.A.C.® Veraflo Cleanse Choice

Dressing as a wound cleansing option before surgical debridement or if debridement is delayed or not possible. When clinical goals are met, it is advised to discontinue therapy.

Choice of NPWT system

Patients may be transitioned from one NPWT system, such as Veraflo Therapy, to another as treatment progresses and therapeutic goals change. An algorithm to guide the transition between different NPWT systems based on clinical and healthcare system considerations for surgical wounds was developed at an advisory panel meeting held in 2019 (Harding et al, 2023; Figure 1).

This algorithm on surgical wounds, along with the nine case studies [Table 2] featured in this case series that are representative of a clinician's everyday use of Veraflo Therapy, may help to guide the appropriate use of this therapy in practice when managing complex wounds.

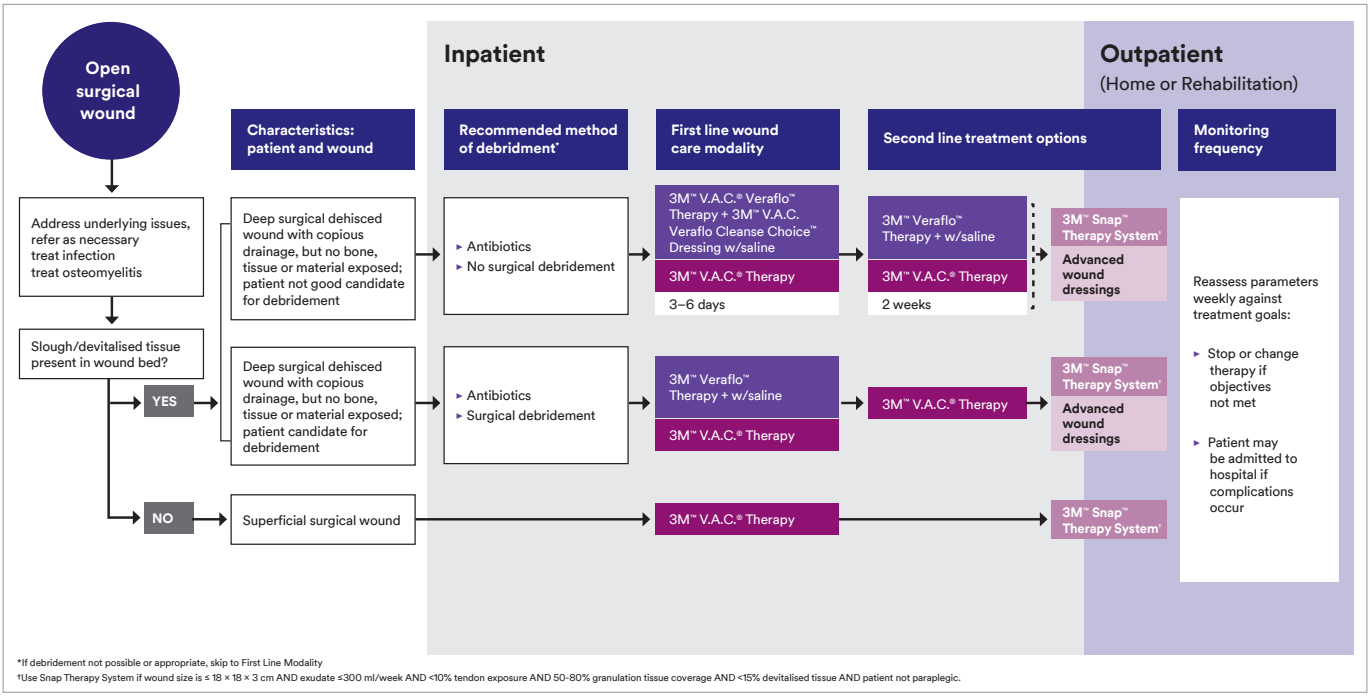

Figure 1. Algorithm to guide the transition between different NPWT systems based on clinical and healthcare system considerations for surgical wounds (Harding et al, 2023)

Table 2. Summary of case studies

Case number	Clinician	Country	Wound type	Page
1	Wan Mun Wong et al	Singapore	Infected amputation wound	6
2	Koh Khai Luen and Normala Binti Haji Basiron	Malaysia	Lower abdomen and perineal wound secondary to Fournier's gangrene	8
3	Sunil Maheshwari and Surabhi Maheshwari	India	Thigh wound and chronic osteomyelitis	10
4	Lee Chin Yen	Malaysia	Complex diabetic foot ulcer	11
5	Leung Ka Chai	Hong Kong	Leg ulcer in a patient with rheumatoid arthritis	12
6	Sunil Maheshwari and Surabhi Maheshwari	India	Non-healing wound and chronic osteomyelitis	14
7	Tay Hsien Ts'ung	Singapore	Diabetic foot wound	16
8	Hardik Dodia	India	Surgical site mucormycosis infection	18
9	Hardik Dodia	India	Diabetes and a complex foot ulcer	20

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CASE 1: Infected amputation wound

Authors: **Wan Mun Wong**, Senior Podiatrist, Yishun Health, Singapore; **Guo Shen Desmond Ooi**, Senior Consultant, General Surgery and Vascular, Mount Elizabeth Medical Centre, Singapore; **Yijun Wu**, Consultant, General Surgery and Plastics, Woodlands Health, Singapore; **Jia-Yi Claris Shi**, Consultant, Orthopaedic Surgery and Foot and Ankle, Yishun Health, Singapore; **Zhiwen Joseph Loe**, Consultant, General Surgery and Vascular, Woodlands Health, Singapore

Patient presentation and history

A 78-year-old woman, with a medical history of hypertension, diabetes mellitus, hyperlipidaemia, peripheral vascular disease and prior bilateral total knee replacement, presented with a wound resulting from a guillotine amputation of the left forefoot. The wound measured 8.5cm (length) x 7cm (width), with no Doppler signals at both the dorsalis pedis artery and posterior tibial artery.

Before the onset of the wound, the patient could ambulate with the aid of a walking stick. She had previously been hospitalised twice due to diabetic foot ulcers and had undergone several procedures, including an unsuccessful left lower limb angioplasty, a left common femoral artery and proximal superficial femoral artery (SFA) endarterectomy, SFA stenting and, eventually, a left forefoot amputation.

Management and outcomes

The patient underwent a left lower limb thrombectomy, along with angioplasty of the SFA, popliteal and anterior tibial arteries, with access through the plantar arch via the dorsalis pedis artery. Following the surgery, successful restoration of Doppler signals was observed at the left dorsalis pedis artery.

Additionally, a wound culture identified the presence of *Pseudomonas aeruginosa*, prompting specific wound care. Initially, the wound was treated with a 0.5% acetic acid soak for 15 minutes and then cleansed with normal saline. Free-range *Lucilia cuprina* maggots were then applied to the wound on both day 1 **[Figure 2]** and day 3 as part of the treatment regimen.

Two days after the initial treatment regimen (day 5), surgical debridement was performed on the wound.

On day 7, the treatment approach was modified and a V.A.C.® Veraflo Cleanse Choice Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling 0.25% acetic acid solution with 5-minute dwell time, followed by two hours of -100mmHg negative pressure **[Figure 3]**. Dressing changes occurred every three days.

Acetic acid was chosen as an instillation solution due to its demonstrated bacteriostatic activity against *Pseudomonas aeruginosa* (Nagoba et al, 2013). The use of topical acetic acid preparations also offers advantages over the prolonged and routine use of antibiotics, reducing the risk of selecting multiple drug-resistant strains of microorganisms in acute settings.

Dressings were changed again on day 10, and the second application of Veraflo Therapy occurred on that day.

Three days later (day 13), free-range *Lucilia cuprina* maggots were applied once more to the wound **[Figure 4]**.

At the next dressing change three days later (day 16), V.A.C.® Veraflo Cleanse Choice Dressing was placed again over the wound bed and Veraflo Therapy was initiated by instilling 0.25% acetic acid solution with 5-minute dwell time, followed by two hours of -100mmHg negative pressure **[Figure 5]**.

Between day 14 and day 28, substantial improvement was observed in the wound's condition, characterised by increased granulation tissue formation and a reduction in slough. During this period, the wound size decreased to 8cm (length) x 6.4cm (width).

By day 24 of treatment, positive improvements in the wound prompted a modification in the treatment approach from Veraflo Therapy to V.A.C.® Therapy with V.A.C.® Granufoam™ Dressing **[Figure 6]**.

On day 30, a split-skin graft procedure was performed to facilitate wound closure. Subsequently, standard NPWT (V.A.C.® Therapy) was continued as part of the treatment regimen.

Conclusion

Maggot therapy in addition to Veraflo Therapy and V.A.C.® Therapy proves to be a valuable adjunct therapy in the treatment of ischaemic diabetic foot ulcers. In this specific case, wound closure was successfully achieved through the application of a split-thickness skin graft after a 4-week period with the help of both Veraflo Therapy and V.A.C.® Therapy. This approach not only significantly reduced direct costs but also notably improved the patient's quality of life.

The clinician believes that in the absence of Veraflo Therapy, the use of traditional dressings would have necessitated more than a month for the wound to heal. Such a prolonged healing period could have led to an extended hospital stay, reduced quality of life for the patient and an elevated risk of additional complications, including infection or the need for a major amputation.

References

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Case 1. Infected amputation wound

Figure 2. Wound at initial presentation showing positive *Pseudomonas aeruginosa* culture, followed by the application of free-range *Lucilia cuprina* maggots (day 1)

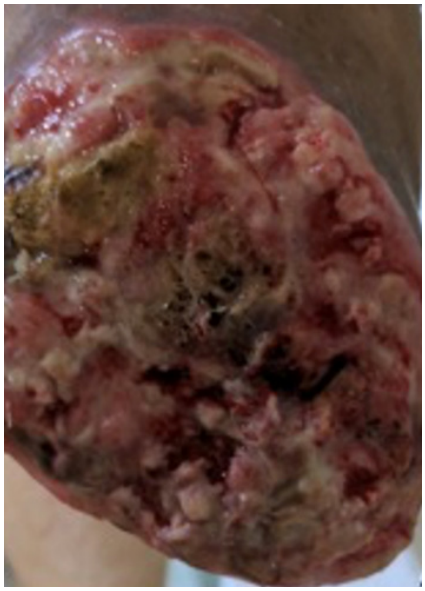


Figure 3. Post-surgical debridement, followed by the initiation of Veraflo Therapy with V.A.C.® Veraflo Cleanse Choice Dressing (day 7)

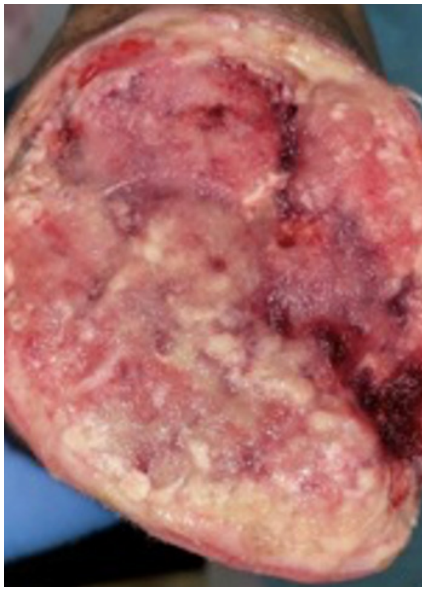


Figure 4. Post-application of free-range *Lucilia cuprina* maggots (day 13)

Figure 5. After 9 days (day 16) of Veraflo Therapy with V.A.C.® Veraflo Cleanse Choice Dressing, treatment was continued using the same Veraflo Therapy settings

Figure 6. After 17 days (day 24), treatment was transitioned to V.A.C.® Therapy with V.A.C.® Granufoam™ Dressing

CASE 2: Extensive lower abdomen and perineal wound secondary to Fournier's gangrene

Authors: **Koh Khai Luen,** Plastic Surgeon, Hospital Kuala Lumpur, Malaysia; **Normala Binti Haji Basiron**, Head and Senior Consultant of the Plastic and Reconstructive Surgery Department, Kuala Lumpur Hospital, Malaysia

Patient presentation and history

A 56-year-old man with type 2 diabetes mellitus presented with painful swelling and redness in the perineal and scrotal region, which had been ongoing for one week. He also reported experiencing a fever, chills and pus discharge from the genitalia area.

On presentation, the patient was in septic shock, necessitating resuscitation and critical care. Clinical examination revealed a necrotic patch over the scrotal region with erythema affecting the penile shaft, glans and perianal regions. Notably, extensive crepitus was palpable over the lower abdomen, indicating a high suspicion of necrotising fasciitis as the likely diagnosis.

Management and outcomes

Following haemodynamic stabilisation, addressing diabetic control, and managing sepsis, the patient underwent an emergency penectomy, bilateral orchidectomy, diversion colostomy and suprapubic catheterisation, as well as extensive surgical debridement of the lower abdomen skin.

Subsequently, following three sessions of surgical debridement and the application of wet-to-dry gauze dressings, the patient was referred to the plastic and reconstructive surgery department for ongoing wound management and definitive closure. During dressing changes, the patient reported wound pain at a level of 7 out of 10, with 10 being the worst, which was effectively managed with oral analgesia prior to the changes.

The wound extended from the lower abdomen below the umbilicus to the perianal region and from the bilateral flanks, measuring 42cm (length) x 32cm (width) x 3cm (depth). The lower abdomen skin edge was covered with desiccated fascia and desiccated fat tissue [Figure 7]. Tissue culture revealed multiple organisms, with *Klebsiella pneumonia* being the predominant organism, which was sensitive to Ceftriaxone. Given the patient's general condition and the unprepared wound bed for definitive wound coverage with a skin graft, he underwent an additional three sessions of surgical wound debridement under general anaesthesia in the operating room.

A V.A.C.® Veraflo Cleanse Choice Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling 50cc of normal saline with 5-minute dwell time, followed by 3.5 hours of -125mmHg negative pressure. Dressing changes occurred every three days in the operating room to maintain sterility and minimise discomfort for the patient.

To ensure a good seal at the wound edges due to the difficult-to-dress area, a hydrocolloid adherent dressing was used around the wound edges to prevent microleakage and maceration of periwound skin from wound exudate and instillation fluid.

Following the procedure, the patient reported a reduction in wound pain, rating it 2 out of 10. There was a significant improvement after one session of surgical debridement and Veraflo Therapy, with granulation tissue covering more than 80% of the wound [Figure 8]. The wound showed further improvement by the second session of surgical debridement and dressing change, with granulation tissue covering almost the entire wound and complete obliteration of all skin flap undermining and pockets with granulation tissue [Figure 9].

After the third session of surgical debridement and dressing change [Figure 10], the patient underwent definitive wound closure with a split-thickness skin graft. The wound was debrided and cleansed with saline and 0.5% chlorhexidine aqueous solution. The skin graft was applied to the wound bed and secured with skin staples and absorbable sutures [Figure 11a–b].

To further secure the skin graft, the treatment approach was modified from Veraflo Therapy to standard NPWT (V.A.C.® Therapy) with V.A.C.® Granufoam™ Dressing at a lower negative pressure of -75mmHg to prevent shearing of the skin [Figure 12a]. Additionally, a silicone sheet was applied to protect the skin graft from adhering to the V.A.C.® Granufoam™ Dressing [Figure 12b].

Post-surgery, the graft exhibited a 98% take, with a small area of slough noted. This residual slough was effectively managed using conventional dressings [Figure 13], and the patient was discharged from the hospital.

Conclusion

Necrotising soft tissue infections can cause extensive skin damage due to the rapid spread of infection along loose fascial planes. In the case of Fournier's gangrene, the infection may extend to the torso and perineal region, necessitating fecal and urinary diversion to prevent wound contamination. As a result, prior to the initiation of Veraflo Therapy, this patient underwent diversion colostomy, suprapubic catheterisation and extensive surgical debridement of the lower abdomen skin.

Despite the patient's critical illness and suboptimal systemic health at the outset of the first dressing change with Veraflo Therapy, this treatment regimen notably reduced wound pain compared to traditional wet-dry dressings with gauze and saline. Additionally, after just one dressing change, healthy granulation tissue was observed in the wound bed, and tissue culture confirmed the eradication of *Klebsiella pneumonia* and sloughy tissue.

For this patient, using V.A.C.® Therapy at a low pressure of -75mmHg in continuous mode effectively secured the skin grafts in the challenging-to-immobilise areas, such as the perineum. This method prevented skin graft shearing and notably improved graft adherence. The adaptability of the 3M™ V.A.C.® Ulta Therapy Unit, allowing a seamless transition to standard NPWT when instillation was unnecessary, was additionally a significant advantage.

Case 2. Extensive lower abdomen and perineal wound secondary to Fournier's Gangrene

Figure 7. Wound at initial presentation of extensive lower abdomen and perineal wound

Figure 8. Wound bed after the first session of surgical debridement and Veraflo Therapy

Figure 9. Wound bed after two sessions of surgical debridement and Veraflo Therapy

Figure 10. Wound bed after three sessions of surgical debridement and Veraflo Therapy

Figure 11a–b. (a) Harvested skin graft from the left thigh (indicated by the bandaged area) following wound debridement (b) Left lateral view of application of meshed skin graft on the cleansed and debrided wound, secured with skin staples and sutures

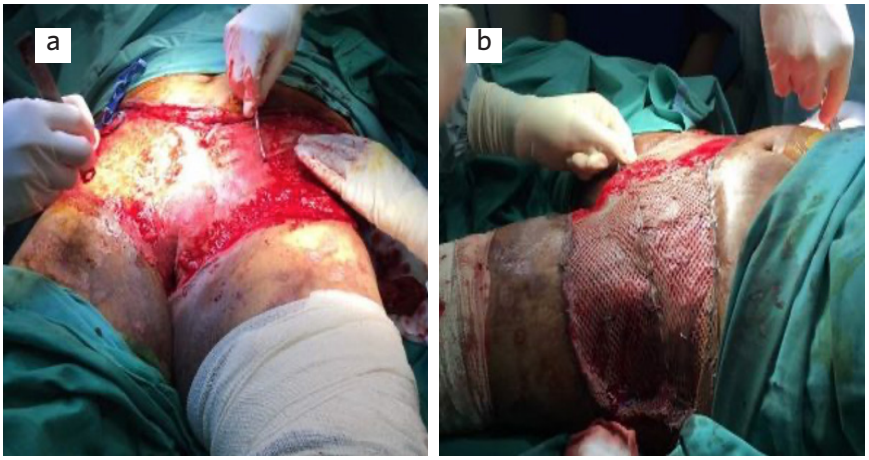


Figure 12a–b. (a) Pre-application of V.A.C.® Granufoam™ Dressing and a silicone sheet to prevent skin shearing (b) Post-initiation of V.A.C.® Therapy with V.A.C.® Granufoam™ Dressing

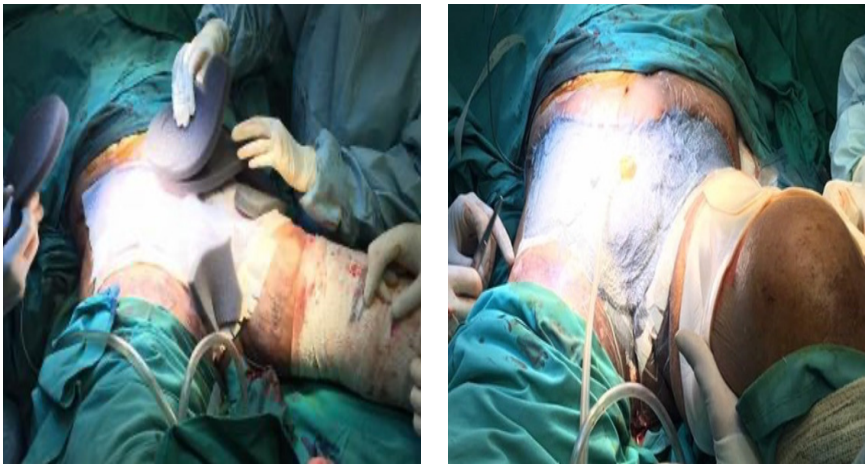


Figure 13. Ten days post-skin graft and initiation of V.A.C.® Therapy with V.A.C.® Granufoam™ Dressing

CASE 3: Management of a patient with a thigh wound and chronic osteomyelitis

Authors: **Dr Sunil Maheshwari**, Orthopaedic Doctor, Prime Care Hospital, Visiting Consultant, Medilink, SAL, Sanjivani, Marengo CIMS Hospital, Sterling Hospital, Ahmedabad, India; **Surabhi Maheshwari**, Medical Student, GMERS Medical College and Civil Hospital, Ahmedabad, India

Patient presentation and history

A 69-year-old patient with a medical history of diabetes mellitus was admitted with left proximal femur osteomyelitis, a recurring condition from surgery 14 years prior, causing severe left thigh pain for two months. Magnetic resonance imaging findings revealed a collection of intramedullary and extraosseous abscesses measuring 10cm (length) x 2.5cm (width) x 2cm (depth) and 9cm (length) x 2.5cm (width) x 2cm (depth), respectively.

Management and outcomes

Incision and drainage of the abscesses along with saucerisation and curettage of the bone cavity was performed. After optimal debridement [Figure 14] and a computerised tomography (CT) scan, a V.A.C.® Veraflo Therapy Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling 20ml of normal saline with 10-minute dwell time, followed by 3.5 hours of -125mmHg negative pressure. Dressing changes occurred every three days, accompanied by repeated bone curettage to address identified dead bone fragments from the CT scan report.

At the second and third dressing changes (days 6 and 9), there was a reduction in pain and wound size and an increase in granulation tissue [Figures 15 and 16].

After 11 days, wound volume had reduced significantly by 80%. Veraflo Therapy was discontinued, and the wound was primarily closed with staples [Figure 17].

At a follow-up appointment eight weeks later, the wound was healing without complications [Figure 18], and six months after closure, the wound remained closed.

Conclusion

Osteomyelitis often requires prolonged antibiotic therapy and in severe cases, surgical interventions, such as debridement or amputation, may become necessary. In cases of chronic osteomyelitis, open surgery is typically performed to open the involucrum and remove the sequestrum. Additionally, saucerisation, a procedure involving tissue debridement to create a shallow shelving depression, may be considered to facilitate drainage.

In this specific case, however, Veraflo Therapy was used with the primary objective of creating an environment conducive to wound healing. This is achieved through the reduction of bacterial bioburden and improved perfusion at the wound site.

Veraflo Therapy contributed to:

- A shorter recovery period
- Prevention of secondary infections
- Maintenance of a moist wound environment that supports healing through intermittent instillation of normal saline
- Increased patient quality of life.

Case 3. Management of a patient with a thigh wound and chronic osteomyelitis

Figure 14. Wound at initial presentation post-extensive bone debridement

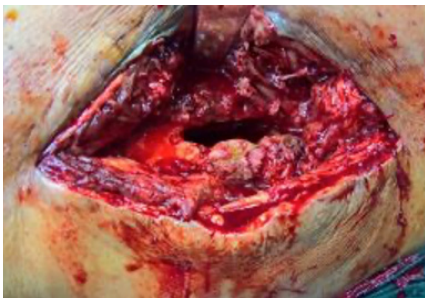


Figure 15. Wound after second session of Veraflo Therapy (day 6)

Figure 16. Wound after third session of Veraflo Therapy (day 9)

Figure 17. Wound after four sessions of Veraflo Therapy and demonstrating the final closure achieved using staples (day 11)

Figure 18. Follow-up appointment of healed wound (8 weeks)

CASE 4: Management of a complex diabetic foot ulcer

Authors: **Lee Chin Yen**, MBBS, MSc, WHTR, Fellowship in Wound Healing, Head of Wound Care Unit, Hospital Tengku Ampuan Afzan Kuantan, Pahang, Malaysia

Patient presentation and history

A 36-year-old man with a medical history of diabetes mellitus, ischaemic heart disease and congestive cardiac failure presented with a diabetic foot ulcer that had been infected for two weeks, resulting in abscess formation [Figure 19].

Initially admitted for an incision and drainage procedure on the left foot, the wound became complicated with persistent pus discharge and signs of infection. Despite medical advice for a below-knee amputation, the patient declined and left the hospital against recommendations. The following day, he sought care at another tertiary hospital, presenting symptoms of fever, chills and tachycardia. Clinically, the wound displayed large amounts of pus and discharge, along with surrounding maceration and erythema.

Management and outcomes

The patient strongly refused major amputation, leading to an alternative approach. This involved extensive wound debridement and bone curettage of the left second metatarsal. Postoperatively, the hindfoot wound measured 18cm (length) x 8cm (width) x 3cm (depth), featuring exposed calcaneal bone, while the forefoot incision wound measured 5cm (length) x 1cm (width) x 3cm (depth), with communication to the metatarsal bone [Figure 20]. Microbiological culture and sensitivity analysis identified the presence of *Klebsiella pneumoniae* with resistance to multiple classes of antibiotics, prompting initiation of intravenous vancomycin therapy.

Due to the patient's extensive wound and persistent infection alongside underlying health conditions, a V.A.C.® Veraflo Therapy Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling normal saline with 10-minute dwell time, followed by six hours of -125mmHg negative pressure. To protect the healthy, intact skin, a hydrocolloid dressing was also applied [Figure 21]. Dressing changes occurred every three days, with the continuous negative pressure phase adjusted to eight hours during the second session.

After 20 days of Veraflo Therapy, healing was observed in the forefoot wound, with reductions in size and depth in the midfoot and hindfoot wounds [Figure 22].

Four months later [Figure 23], while the wound showed significant progress with granulation tissue present, an acute congestive cardiac failure episode postponed the planned full-thickness skin graft. Instead, secondary healing commenced with moist wound dressings and offloading measures.

Conclusion

In this case, a limb salvage operation was performed, involving extensive wound debridement and bone curettage. Despite these interventions, residual infection and a persistent wound defect remained after removing the osteomyelitis.

The use of Veraflo Therapy proved effective in removing infectious materials through repeated cleansing cycles. This approach eliminated the necessity for additional surgical debridement and amputation. Importantly, the procedure was less invasive, eliminating the risks associated with general anaesthesia and resulting in reduced morbidity and mortality. It also promoted increased granulation tissue formation and closure of the incisional wound.

Case 4. Management of a complex diabetic foot ulcer

Figure 19. Wound at initial presentation displaying unhealthy tissue noted over the plantar aspect of the hindfoot and with pus discharge

Figure 20. Post-debridement; hindfoot wound shows exposed calcaneal bone and forefoot incision communicates with the metatarsal bone

Figure 21. Wound bed after first session of Veraflo Therapy — with a hydrocolloid dressing protecting healthy and intact skin

Figure 22. Wound bed after 20 days of Veraflo Therapy

Figure 23. Wound bed after four months of Veraflo Therapy

CASE 5: Wound healing of a leg ulcer in a patient with rheumatoid arthritis

Authors: **Leung Ka Chai**, Advanced Practice Nurse, Department of Orthopaedics and Traumatology, Queen Mary Hospital, Hospital Authority, Hong Kong

Patient presentation and history

A 67-year-old patient with a medical history of seropositive rheumatoid arthritis, spinal stenosis, and mixed anxiety-depressive disorder was admitted through the accident and emergency department with cellulitis and two leg ulcers on the right medial leg. One wound measured 2cm (length) x 3cm (width), and the other measured 5cm (length) x 4cm (width). The wound bed was sloughy; necrotic tissue and purulent discharge were present [Figure 24].

Management and outcomes

The wound was initially surgically debrided, where tissue culture obtained from this session indicated the presence of *Morganella morganii* and *Serratia* species. Following the availability of culture and sensitivity reports, the patient was put on an antibiotic regimen of cefepime. The wound now measured 8.8cm (length) x 4cm (width) x 2cm (depth), with an 8cm tunnelling that exposed the tendon [Figure 25].

The decision was then made by both the orthopaedic surgeon and nurse consultant to initiate Veraflo Therapy to stimulate granulation tissue growth and cleanse the wound. A non-adherent dressing was applied to protect the exposed tendon and a V.A.C.® Veraflo Therapy Dressing was placed over the wound bed. Veraflo Therapy was initiated by instilling normal saline with 10-minute dwell time, followed by four hours of -75mmHg negative pressure. Dressing changes occurred every 48–72 hours.

After 17 days of Veraflo Therapy, a second surgical debridement was performed to remove unhealthy granulation tissue and some affected tendon [Figure 26]. The wound had decreased in length, measuring 8cm (length) x 3cm (width) x 0.5cm (depth). Treatment continued for an additional three days, resulting in a further reduction in wound size.

Veraflo Therapy was continued and by day 27, arrangements were made for partial wound closure using local anaesthesia. Four days later, the wound had significantly reduced in size to 2.5cm (length) x 1.5cm (width) x 0.5cm (depth), exhibiting an 8cm tunnel starting at the wound's inferior aspect. The decision was made to proceed with the existing treatment plan.

The wound continued to improve and partial closure was performed again and further progress in wound healing was noted by day 54 [Figure 27]. Due to persistent purulent discharge, surgical debridement was performed again, followed by suturing of the wound after the operation [Figure 28].

Post-surgical debridement, the treatment approach was modified; Veraflo Therapy was discontinued, and V.A.C.® Therapy was initiated at -75mmHg negative pressure to draw the wound edges together and remove exudate and infectious materials. Dressing changes were carried out every three days. Post-operation, the team regularly assessed the wound and on day 80, they found an opening at the distal part of the wound [Figure 29]. The care team decided the best option was to let the wound heal by secondary intention with the aid of Veraflo Therapy to provide continuous wound cleansing and promote wound healing.

The application of Veraflo Therapy, at -75mmHg negative pressure, was continued until the wound achieved complete healing, which occurred approximately four months after initial presentation [Figure 30].

Following full wound recovery, the patient was discharged from the hospital and maintained a healed status during subsequent outpatient clinic visits.

Conclusion

Veraflo Therapy played a crucial role in facilitating wound healing by stimulating granulation tissue formation in the wound bed, effectively cleansing the wound and eliminating exudate and infectious materials. This treatment approach notably reduced the necessity for surgical interventions, consequently decreasing both the duration of hospital stays and the number of operating room sessions.

Without the use of Veraflo Therapy, managing the wound with conventional dressings would have been significantly prolonged, potentially hindering wound healing and escalating the risk of further wound infection or even sepsis. Thus, Veraflo therapy emerged as a valuable system in effectively managing these two infected leg ulcers, actively contributing to the promotion of wound healing.

Case 5. Wound healing of a leg ulcer in a patient with rheumatoid arthritis

Figure 24. Wound at initial presentation

Figure 25. Wound post-surgical debridement and standard dressing use

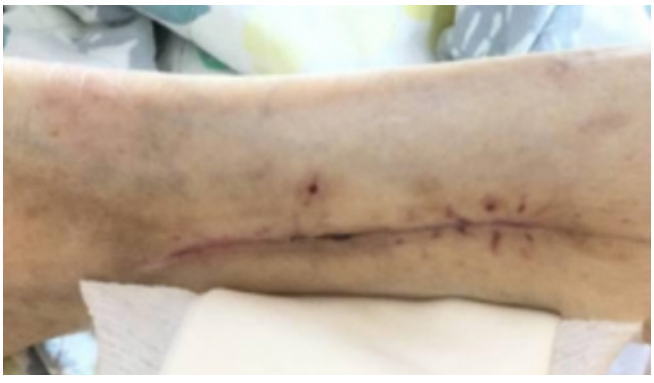
Figure 26. Wound after 17 days of Veraflo Therapy

Figure 27. Wound after 54 days of Veraflo Therapy

Figure 28. Wound after 74 days of Veraflo Therapy

Figure 29. Wound after 80 days of Veraflo Therapy

Figure 30. Wound fully healed (approximately four months after presentation)



CASE 6: Management of a patient with a non-healing wound and chronic osteomyelitis

Authors: **Dr Sunil Maheshwari**, Orthopaedic Doctor, Prime Care Hospital, Visiting Consultant, Medilink, SAL, Sanjivani, Marengo CIMS Hospital, Sterling Hospital, Ahmedabad, India; **Surabhi Maheshwari**, Medical Student, GMERS Medical College and Civil Hospital, Ahmedabad, India

Patient presentation and history

A 55-year-old man with a medical history of uncontrolled diabetes mellitus presented to the hospital with a non-healing wound over the proximal third of the tibia. The wound, measuring 2cm (length) x 3cm (width) x 4cm (depth), displayed two discharging sinuses [Figure 31]. The wound developed six months after the patient had undergone nail and supplementary plate fixation of a proximal tibial fracture. To control infection, debridement was performed and implants were removed. Additionally, a muscle flap and an external fixator were applied to facilitate wound closure.

Despite initiating antibiotics according to culture and sensitivity reports, the wound persisted in producing purulent discharge, leading to septicaemia in the patient. Culture findings revealed pan-resistant strains of *Acinetobacter* and *Klebsiella*.

Management and outcomes

The treatment plan included surgical debridement of necrotic, infected soft tissue and bone [Figure 32]. Subsequently, a V.A.C.® Veraflo Cleanse Choice Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling saline with 10-minute dwell time, followed by four hours of -125mmHg negative pressure. Dressing changes occurred every three days.

On day two of treatment with Veraflo Therapy, the patient's general condition showed improvement. However, culture reports indicated no change in the presence of colonising bacteria, specifically the pan-resistant strains of *Acinetobacter* and *Klebsiella*.

During the first dressing change (day 3), a decrease in the wound gap and swelling was observed [Figure 33], indicating positive progress despite the persistent presence of the resistant bacteria.

At the second dressing change, there was a further reduction in wound size, along with increased granulation tissue formation [Figure 34]. The patient's overall condition improved, allowing for knee mobilisation with partial weight-bearing. The patient remained on a broad-spectrum antibiotic for an additional five days.

Following the third dressing change, the wound gap showed substantial progress, nearly filled, with further evident granulation tissue formation [Figure 35].

Therefore, positive improvements in the wound prompted a modification in the treatment approach from Veraflo Therapy to V.A.C.® Therapy for the subsequent three days. At the end of this period, the wound defect was almost entirely covered, leaving a small open area featuring a healthy granulating bed. To address this, a simple partial thickness skin graft was applied, supported by V.A.C.® Therapy to aid in graft adherence [Figure 36].

At the first dressing change following the graft application, the wound was completely covered with the graft, showing no indications of graft rejection and minimal surrounding wound swelling [Figure 37]. This approach allowed for the control of the infection and facilitated the gradual healing of the fracture with the Ilizarov fixator.

Conclusion

In this case of post-traumatic osteomyelitis coupled with a bacterial infection resistant to multiple antibiotics, successful wound management was achieved by implementing implant removal, thorough debridement, and the combined use of Veraflo Therapy alongside Ilizarov ring fixation. This treatment approach allowed for continuous wound irrigation without the need for multiple surgical procedures. As a result, it not only reduced the overall cost of treatment but also promoted the healing of the wound, leading to a positive outcome for the patient.

Case 6. Management of a patient with a non-healing wound and chronic osteomyelitis

Figure 31. Wound pre-surgical debridement of necrotic, infected soft tissue and bone

Figure 32. Wound post-surgical debridement of necrotic, infected soft tissue and bone

Figure 33. Wound bed after first session of Veraflo Therapy

Figure 34. Wound bed after second session of Veraflo Therapy

Figure 35. Wound bed after third session of Veraflo Therapy

Figure 36. Wound post-split-thickness skin graft

Figure 37. Wound status two weeks after split-thickness skin graft

CASE 7: Diabetic foot wound temporisation and in support of local flap closure

Author: **Tay Hsien Ts'ung**, Consultant, Vascular and Endovascular Surgery Department, Singapore General Hospital, Singapor

Patient presentation and history

A 65-year-old woman with a medical history of type 2 diabetes mellitus, severe ischaemic heart disease, hypertension and hyperlipidaemia, presented with gangrene in the second and third toes, with extension to the base of the fourth toe and plantar tracking to the right midfoot [Figure 38a–b].

Initially, the patient underwent a complete ray amputation of the right second, third and fourth toes, along with drainage of a plantar abscess that extended into the midfoot. Subsequent to this, a right lower limb angioplasty was performed to address severe peripheral arterial disease. The angioplasty focused on her superficial femoral, popliteal and tibial arteries. Unfortunately, attempts to recanalise the anterior and posterior tibial arteries were unsuccessful due to chronic occlusion of the common plantar artery, resulting in poor runoff to the foot, sustained only by a single peroneal artery [Figure 39]. A subsequent attempt to reopen the tibial vessels was also unsuccessful a week later.

Intraoperative cultures later confirmed the presence of various bacteria: *Acinetobacter baumannii*, *Escherichia coli* and *Staphylococcus aureus* from the fourth metatarsal head; *Enterococcus faecalis* from the second and third metatarsal heads; and *Proteus mirabili*, *Candida parapsilosis* and *Trichosporon asahii* from the soft tissue. These infections were managed with targeted systemic antibiotics and antifungal therapy.

Management and outcomes

Following surgery and a systemic antibiotic regimen for infection, a V.A.C.® Veraflo Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling hypochlorous acid topical wound solution with 10-minute dwell time, followed by 3.5 hours of -125mmHg negative pressure. Dressing changes occurred every three days.

Upon assessment, there was no evidence of granulation tissue formation, but gradual localised necrosis was observed at the wound edge. After several sessions of debridement, the wound had increased in size and measured 4cm (length) x 10cm (width) [Figure 40].

Angioplasty was subsequently reattempted, which resulted in the establishment of straight-line flow to the foot via the posterior tibial and lateral plantar arteries [Figure 41a–c].

Within 24 hours, significant improvement was observed in the patient's foot. The first and fifth toes regained a healthy pink colour and warmth. However, due to capsule exposure at the first metatarsal-phalangeal joint and instability in the medial-lateral joint, the decision was made to amputate both toes and debride the wound base [Figure 42a–c].

Post-amputation, the plantar defect was initially dressed with povidone-iodine gauze. However, due to the accumulation of slough within the wound bed, Veraflo Therapy was reinstated two days after the amputation [Figure 43].

Three weeks later, the wound was sutured, and a week following the suturing, the suture line demonstrated good union [Figures 44a–c].

During an outpatient follow-up a month later, the wound was near complete healing [Figure 45a–b].

Conclusion

The use of Veraflo Therapy with V.A.C.® Veraflo Dressing as an adjunctive therapy helped to enable this patient's recovery. The application of Veraflo Therapy with V.A.C.® Veraflo Dressing played a crucial role in restoring blood flow to the lower extremity, supporting flap retention and, ultimately, achieving complete wound closure after subsequent angioplasty. Given the high bacterial presence, Veraflo Therapy was also beneficial for removing non-viable tissue and effectively cleaning the wound bed. This approach also helped mitigate potential flap loss, improved the amputation wound by solubilising and removing slough, and promoted adequate granulation tissue development in the plantar defect.

Veraflo Therapy with V.A.C.® Veraflo Dressing emerges as an important adjuvant tool for clinicians treating severe complicated diabetic foot wounds with osteomyelitis and underlying peripheral arterial disease. Additionally, from a healthcare system perspective, significant savings were recognised due to reduced operating theatre time and associated costs related to staff and consumables.

Case 7. Diabetic foot wound temporisation and in support of local flap closure

Figure 38a–b. (a) Anterior view and (b) posterior view of the right midfoot, demonstrating gangrene affecting the second, third and fourth toes, along with evidence of a tracking plantar abscess extending to the midfoot

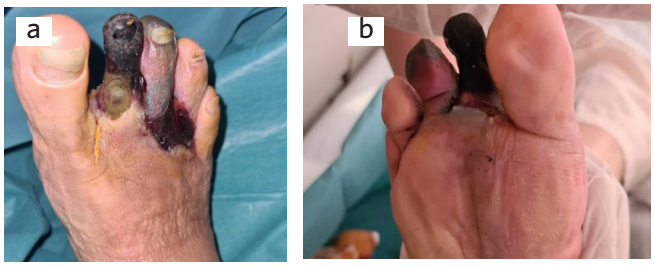


Figure 39. Foot angiogram revealing poor runoff to the forefoot from the peroneal artery following angioplasty of the larger proximal vessels

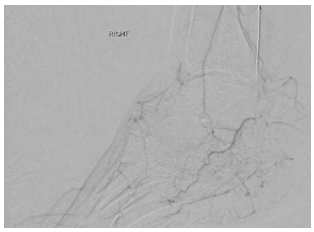


Figure 40. Lateral enlargement of the postsurgical wound over the course of three weeks due to successive sessions of bedside debridement

Figure 41a–c. Selective angiograms of the lateral plantar artery. (a) Pre-angioplasty angiogram in the antero-posterior view (b) pre-angioplasty angiogram in the lateral view (c) post-angioplasty angiogram of the posterior tibial artery extending into the forefoot, revealing a healthy wound perfusion

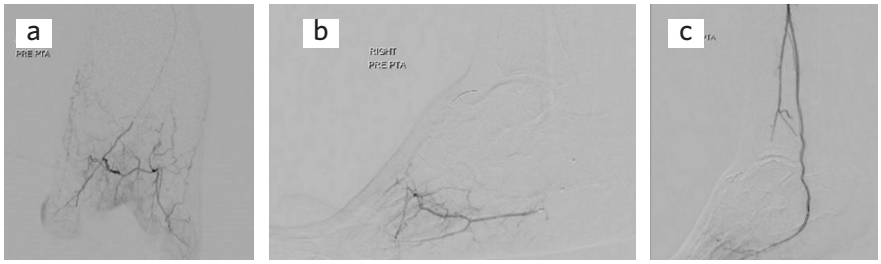
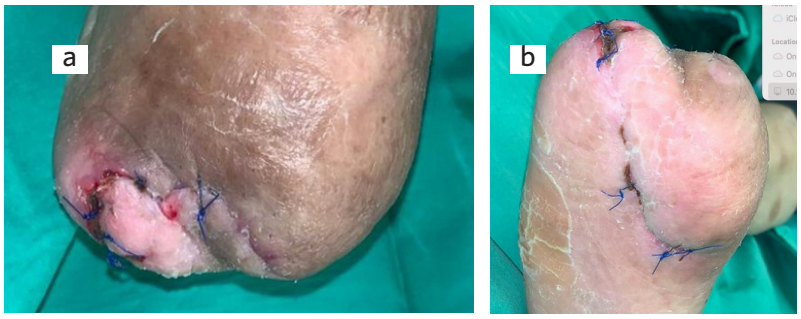


Figure 42a–c. Partial closure of the post-amputated wound was achieved using a local skin flap harvested from the medial aspect of the first digit, resulting in a remaining plantar defect

Figure 43. Postoperative plantar defect occupied with slough prior to restarting Veraflo Therapy for wound bed cleansing

Figure 44a–c. Good union of the suture line was maintained three weeks after ray amputations with toe flap surgery

Figure 45a–b. Wound nearing complete healing seven weeks after ray amputation with toe flap surgery



CASE 8: Treatment of surgical site mucormycosis

Author: **Dr Hardik Dodia**, Consultant Plastic Surgeon, Krishna Shalby Hospital, SG Shalby Hospital, India

Patient presentation and history

A 43-year-old man was admitted to the hospital after a road traffic accident while riding a motorcycle causing injury to his right arm. The patient reported severe pain and swelling, and an X-ray indicated a proximal humerus fracture. Preoperative investigations were conducted, and upon clearance for surgery, the patient underwent humerus plating using the proximal humerus interlocking system through the deltopectoral approach. The surgery was successful, and the patient was discharged four days postoperatively with dry dressings.

A week later, following two dressing changes outside the hospital, the patient reported redness, pain along the stitch line and pus discharge. Upon immediate reevaluation, the patient displayed symptoms of a high-grade fever, severe pain and pus discharge along the stitch line, indicating a potential infection [Figure 46].

The patient's stitches were promptly removed, and the discharged pus was cultured for examination. Initially, Cefoperazone-sulbactam and Amikacin antibiotics were empirically administered. Subsequently, upon identifying methicillin-resistant *Staphylococcus aureus* sensitivity to linezolid and vancomycin in the pus culture, the treatment was adjusted to include these medications.

Despite these adjustments, the wound exhibited resistance to linezolid and vancomycin. During a follow-up dressing change, the wound condition worsened, revealing the presence of punctate spots of pus, black watery discharge, and malodour, all symptoms typical of mucormycosis infection [Figure 47].

Management and outcomes

Tissue culture confirmed a mucormycosis infection, prompting immediate treatment with Amphotericin B injection. An immediate decision was made to proceed with surgical wound debridement in the operating theatre, removing all visibly affected tissue [Figure 48].

The following day, the wound measured 30cm (length) x 15cm (width) x 3cm (depth). Considering both the size of the wound and the patient's comorbidities, a V.A.C.® Veraflo Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling saline with 8-minute dwell time, followed by three hours of -125mmHg negative pressure. Dressing changes occurred every three days.

After 12 days of treatment, a reduction in slough and an increase in granulation tissue in the wound were observed [Figure 49], reaching a stage where the wound became suitable for a skin graft [Figure 50].

The skin graft gradually settled over time [Figure 51]. Simultaneously, the patient received oral antifungal treatment for an additional four weeks to manage and prevent potential fungal infections.

Conclusion

This case study demonstrates the successful application of Veraflo Therapy for 12 days subsequent to the surgical debridement of an infected wound following surgery for a proximal humerus fracture. This method effectively facilitated wound healing, stimulated granulation tissue formation and efficiently removed slough. As a result, it significantly reduced the patient's hospital stay by expediting the time required for wound coverage.

Case 8. Treatment of surgical site mucormycosis

Figure 46. Infected stitch at initial presentation

Figure 47. Infected wound during follow-up dressing changes

Figure 48. Wound post-surgical debridement to remove all visibly affected tissue

Figure 49. Granulated wound after 12 days of Veraflo Therapy with V.A.C.® Veraflo Dressing

Figure 50. Wound post-skin graft

Figure 51. Settled skin graft at follow-up appointment

CASE 9: Management of a patient with diabetes and a complex foot ulcer

Author: **Dr Hardik Dodia**, Consultant Plastic Surgeon, Krishna Shalby Hospital; SG Shalby Hospital, India

Patient presentation and history

A 65-year-old man with a medical history of diabetes mellitus and a previous right leg amputation due to diabetic gangrene, presented at the hospital with a left foot ulcer. He exhibited symptoms including a high-grade fever, necrosis, offensive-smelling purulent exudate, and the presence of maggots [Figure 52].

Emergency surgical debridement was performed and the patient was administered empirical intravenous antibiotics. Cultures taken from the debrided tissue and subsequent antibiotic sensitivity tests revealed a *Pseudomonas aeruginosa* infection. Accordingly, the antibiotic regimen was adjusted based on the sensitivity results.

Management and outcomes

Post-debridement, the wound measured 14cm (length) x 8cm (width) x 3cm (depth) [Figure 53]. Due to the patient's comorbidities, a V.A.C.® Veraflo Dressing was placed over the wound bed and Veraflo Therapy was initiated by instilling 16ml of normal saline with 10-minute dwell time, followed by four hours of -125mmHg negative pressure. Dressing changes occurred every three days, with sequential sharp debridement performed at the bedside.

At the first dressing change, after three days of treatment, there was an increase in healthy granulation tissue and a reduction in overall slough in the medial aspect of the wound [Figure 54a–b].

By day six of treatment, positive improvements in the wound prompted a transition from Veraflo Therapy to V.A.C.® Therapy at -125mmHg negative pressure with V.A.C.® Granufoam™ Silver Dressing [Figure 55a-b]. Further sharp debridement was performed [Figure 56].

Following six days of V.A.C.® Therapy with V.A.C.® Granufoam™ Silver Dressing [Figure 57a–b], the wound was deemed ready for skin grafting using a split-thickness skin graft [Figure 58a–b]. At the 3-week follow-up, the graft demonstrated a take of over 95% [Figure 59]. By six weeks, complete wound closure was achieved [Figure 60]. Subsequently, a prosthesis was fitted, restoring the patient's mobility.

Conclusion

In this case, Veraflo Therapy helped to reduce the need for debridement and length of hospital stay by reducing time to wound coverage and risk of amputation. Compared to conventional dressings, which might have extended the treatment duration, Veraflo Therapy proved instrumental in achieving faster results. This helped to minimise the patient's length of stay but also lowered the risk of further infections, reducing the likelihood of additional surgeries for debridement or washout. Overall, this case demonstrates that the use of Veraflo Therapy has the potential to reduce the overall cost of treatment and serves as a valuable tool in healing people with diabetes and complex foot ulcers.

Case 9. Management of a patient with diabetes and a complex foot ulcer

Figure 52. Wound at presentation

Figure 53. Wound after initial debridement

Figure 54a–b. After three days of Veraflo Therapy with V.A.C.® Veraflo Therapy Dressing

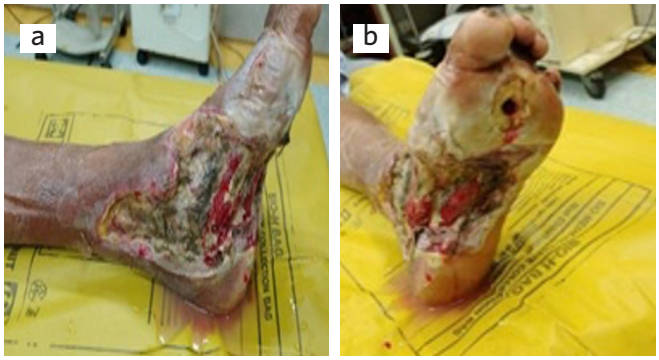


Figure 55a–b. After six days of Veraflo Therapy with V.A.C.® Veraflo Therapy Dressing

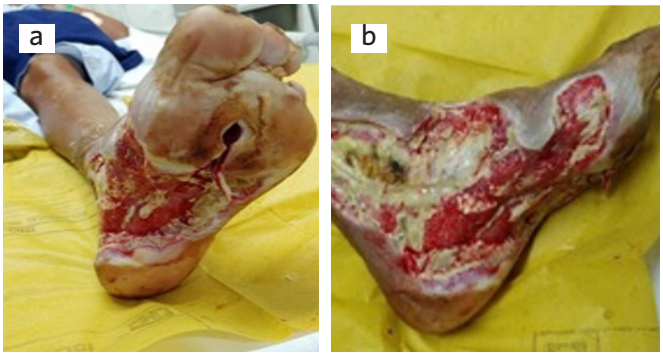


Figure 56. Wound after repeated sharp debridement

Figure 57a–b. After 6 days of V.A.C.® Therapy with V.A.C.® Granu-foam™ Dressing

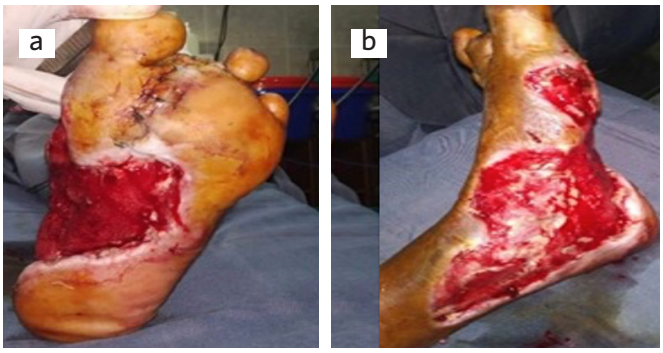


Figure 58a–b. Application of split-thickness skin graft

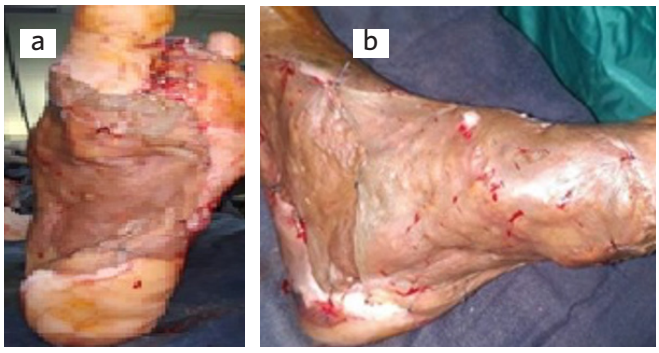


Figure 59. Healthy skin graft three weeks after grafting procedure

Figure 60. Healed and closed wound six weeks after grafting procedure and eight weeks after initial presentation

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