Clinical impacts of NPWTi in managing necrotising fasciitis following an insect bite


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Severely infected wounds are challenging for clinicians and require a carefully considered management plan. Negative pressure wound therapy with instillation (NPWTi) can help as it can save time, effort and even patients' lives. NPWTi is a modification of the conventional NPWT as an adjunctive treatment in the management of acute and chronic wound infections, combining the benefits of NPWT with the addition of controlled delivery of topical solutions (such as cleansers, antiseptics and antibiotics) to the wound bed (Kim et al, 2013). This case study examines the patient journey of an individual presenting with a range of symptoms after experiencing an insect bite. The patient was diagnosed with cellulitis, lymphangitis, skin ulcer, lymphadenitis, post-traumatic wound infection and necrotising fasciitis. The case illustrated the positive effects of NPWTi in terms of cleaning the wound and reducing pathogen bioburden.

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Necrotising fasciitis (NF), commonly known as flesh-eating disease, is an infection that results in the death of soft tissue in different parts of the body (Centers for Disease Control and Prevention [CDC], 2016). The term 'necrotising fasciitis' first came into use in 1952 (Paz Maya et al, 2014; Wilson, 1952). Necrotising fasciitis is most commonly caused by an infection with group A *Streptococcus* (Healthline, 2018). It is a severe disease of sudden onset that spreads rapidly (CDC, 2016). Symptoms include red or purple skin over the affected area, severe pain, fever and vomiting (CDC, 2016). The most commonly affected areas are the limbs and perineum (Hakkarainen et al, 2014). Risk factors include poor immune function, such as from diabetes or cancer, obesity, alcoholism, intravenous drug use and peripheral artery disease (Hakkarainen et al, 2014; CDC, 2016).

In addition to looking at patient's skin, the clinician may perform several tests to diagnose this condition. They may take a biopsy, which is a small sample of the affected skin tissue, for examination (Healthline, 2018). In other cases, blood tests, CT, or MRI scans may help the clinician make a diagnosis reference. Blood tests can show if the muscles have been damaged (Healthline, 2018). This is usually treated with surgery to remove the infected tissue, and intravenous antibiotics (Hakkarainen et al, 2014; CDC, 2016). Necrotising fasciitis occurs in about 0.4 people per 100,000 per year in the US, and about 1 per 100,000 in Western Europe (Paz Maya et al, 2014). Both sexes are affected equally (Hakkarainen et al, 2014). It becomes more common among older people and is rare in children (Paz Maya et al, 2014).

Necrotising fasciitis' management objectives

The treatment for necrotising fasciitis involves the principles of treatment for any kind of surgical infection (Anaya and Dellinger, 2007):

- Source control (debridement and contentious cleansing/irrigation)
- Antimicrobial therapy
- Organ support (nutritional support, fluid resuscitation, blood component therapy)
- Monitoring in an intensive care setting.

Source control

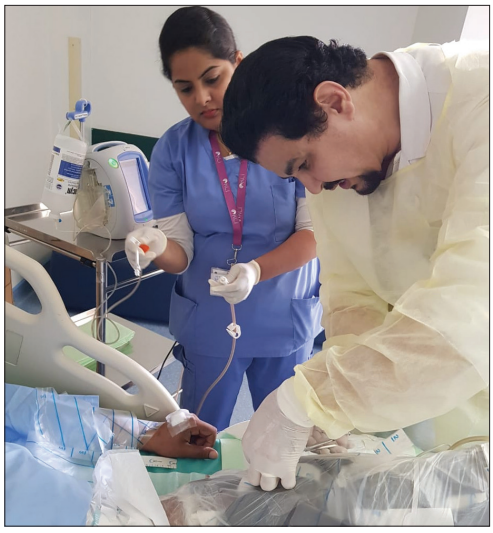
Early recognition and prompt aggressive debridement of all necrotic tissue are needed in addition to intravenous broad-spectrum antibiotics and analgesia (Bilton et al, 1998).

Topical irrigation solution has also been used extensively for wound bed cleansing, debris and exudate removal, and microbial eradication (Kim et al, 2013). Negative pressure wound therapy with instillation (NPWTi) combines the use of

Figure 1. V.A.C. Ulta Therapy System.

Figure 2. Wound 1 week post debridement.

Figure 3. V.A.C. Ulta Therapy System application.



negative pressure wound therapy (NPWT) with a topical irrigation solution. The use of NPWT used in conjunction with instillation provides an important evolution in the NPWT concept, with the potential added benefit of supplying an antimicrobial solution to the wound bed (Kim et al, 2013).

The concepts of suction and wound irrigation are longstanding principles of surgery. Fleischmann et al (1998) reported a gravity-fed intermittent instillation system used in conjunction with NPWT. Kim et al (2013) were able to suggest comparable outcomes in a prospective, randomised, comparative effectiveness study using 0.9% normal saline versus 0.1% polyhexanide, plus 0.1% betaine solution.

In 2003, the first commercially available NPWT device with intermittent instillation was introduced (V.A.C. Instill Wound Therapy System, Kinetic Concepts Inc; Kim et al, 2013). The next generation of NPWT devices with instillation was introduced and has rapidly gained popularity (V.A.C. Ulta Wound Therapy System, Kinetic Concepts Inc; Kim et al, 2013).

The V.A.C. Ulta™ System is an integrated NPWT system that offers standard NPWT (V.A.C.®Therapy) and an instillation option using V.A.C. VeraFlo™ Therapy *[Figure 1]*. This combination system allows instillation solutions to be delivered to the wound bed to help manage complex, difficult to-heal wounds, before converting to standard NPWT for further wound therapy. The V.A.C. Ulta System eliminates the need for a separate NPWT unit and manual application of a topical instillation solution between NPWT cycles (Wounds International, 2012).

A prospective study of patients with the diagnosis of complex, open, infected wounds compared those treated with NPWTi (0.5% silver nitrate solution) with a retrospective control group of patients treated with standard moist wound care therapy. A significant reduction in average days of wound treatments, average days to clear infection, average days to wound closure and average days of hospitalisation was observed in the patients treated with NPWTi (Gabriel et al, 2008).

A retrospective, historical cohort-controlled study assessed the effectiveness of NPWT versus NPWTi in the treatment of infected wounds requiring hospital admission and serial surgical debridement. This showed a significant reduction in the number of operating room visits, time to final surgical procedure, length of hospital stay and percentage of wound closure in the patients treated with NPWTi (Kim et al, 2014).

Another prospective, randomised trial evaluated the effectiveness of NPWTi with dwell (NPWTi-d) on biofilm of chronic wounds versus NPWT. Results showed a significant reduction in

Figure 4. Result after first dressing of V.A.C. Ulta Therapy System application.

Figure 5. After skin graft.

Figure 6. Skin graft before discharge.

quantitative biofilm-protected bacteria after 1 week of treatment: NPWTi (48% reduction) and NPWT (14% reduction; Yang et al, 2017).

Case presentation

The authors present a case of a 24-year-old Indian male who was admitted to hospital on July 1, 2019, after being bitten by an insect on a farm in India 10 days previously. There were no apparent signs and symptoms immediately after the bite, but 2 days later, the patient started to have drainage, bloody discharge, streaking redness and black, hotness, pain (9/10) and erythema to the left lower extremity (indicating wound infection). The patient also experienced associated symptoms, such as fever and vomiting; the patient appeared to be moderately distressed and visibly ill.

In general, the patient was alert and oriented to person, place, time, and situation, with no focal neurological deficit observed; normal sensory and motor functions were observed, with normal speech and coordination.

The patient was diagnosed with cellulitis, lymphangitis, skin ulcer, lymphadenitis, post-traumatic wound infection and necrotising fasciitis. A course of antibiotics was initiated upon admission.

On July 3, debridement was done for the left lower-limb necrotising fasciitis *[Figure 2]*, as before the procedure swelling was reaching to the upper thigh, with an area of necrotic skin lateral aspect oedema and swelling down to the ankle and foot. Gauze was applied after the procedure and the procedure was tolerated very well. A specimen was sent to pathology and the following medications were started:

- Albumin Human 20% Injection (50 mL) 200 mL, IV, Daily
- Linezolid 600mg/300mL Injection 600 mg 300 mL, IV, q12hr
- Metoclopramide 10mg/2mL Injection 10 mg 2 mL, IV, q8hr
- Paracetamol 10 mg/mL (100 mL) Injection 1,000 mg 100 mL, IV, q6hr
- Piperacillin/ Tazobactam Sodium 4g/ 500mg Injection 4.5 gm 1 vial(s), IV, q8hr
- Dextrose 4.3% with 0.18% NaCl solution 2500 mL 2,500 mL, IV, 104.17 mL/hr
- Tramadol 100mg/2mL Injection (CD) 50 mg 1 mL, IM, q12hr.

On July 4, the patient's status was stable with no general abnormalities but there was still swelling on the left leg with redness up to the thigh. The same antibiotic treatment was continued, and the patient transferred to the floor. Many debridement and dressing changes were carried out, and the patient was stable but with no prognosis for the wound. On July 11, debridement was undertaken and the wound was washed with Dermacyn® (MicroSafe Group) then NPWTi was applied (NPWTi unit, Foam dressing, Container, Solution delivery kit) and the settings were as follows: 125 mmHg negative pressure, 6 hours NPWT interval, 20 minutes dwelling time and 140 ml of Dermacyn *[Figure 3]*.

On July 16, the dressing was changed with obvious granulation tissue formation and blood was transfused as the patient's HP was less than 12; so there was a need to elevate HP, in order to accelerate healing of the wound *[Figure 4]*.

On July 22, NPWTi was applied again on the same setting (125 mmHg negative pressure, 6 hours NPWT interval, 20 minutes dwelling time and 140 ml of Dermacyn).

On July 24, the patient was started with alternate day dressing (CACIPLIQ 20®, OTR3) and Aquacel® (ConvaTec).

On July 29, a skin graft was undertaken for the lower lift limb wound and the patient suffered hypotension during surgery, which was managed with administration of intravenous normal saline and one unit of blood *[Figure 5]*.

On August 1, the dressing was changed on the graft and was looking clean but the right thigh dressing was opened and soaked with blood. On August 5, the dressing was changed and the graft was performing well with some blood oozing. On August 19, the wound on the left lower limb was re-grafted with a split-thickness skin meshed graft, having been debrided under general anaesthesia, then fixed with staples. The graft covered with Jelonet® (Smith & Nephew) and diluted betadine gauze and the donor site on both thighs covered with Nanoskin® (Nanoskin Medicals) and pressure bandage. As estimated, blood loss was 300 ml. Offloading was applied as there was pressure injury on the left heel.

On August 22, the dressing was changed over the graft. The dressing over the donor site was left undisturbed (without changing) as there was no complication (wet dressing or smell).

On August 25, the graft had taken, except for a small area on the anterior aspect of the upper leg, and there was purulent discharge. The dressing over the donor site was removed with no complications *[Figure 6]*. CACIPLIQ was applied to the donor wounds and raw areas on the left leg; Aquacel was applied on both thighs and daily dressing (with betadine gauze) for left leg grafted wounds and physiotherapy was initiated for left lower limb. The patient's wounds totally healed and they were discharged on September 8.

Discussion

The results of this study suggest that using NPWTi over a limited period of time may play a positive role in the closure of complex wounds. This technique, combined with surgical debridement and other products, expedited the cleaning and healing of the infection and difficult-to-heal wound in a short period of time.

Conclusion

This case illustrated the positive effects of NPWTi in terms of cleaning the wound and reducing pathogen bioburden. This aided preparation of the wound bed, as it accelerated the healing process and granulation tissue formation for the next step, which was grafting of the wound, as well as reducing the total healing time. Advanced wound management is a collaborative, as well as multidisciplinary, approach. It may encompass many specialties, along with different wound care modalities, to cater for different stages of wound prognosis. WME

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