The use of larval debridement therapy in preventing further amputation

KEY WORDS
- Amputation
- Complex
- Debridement
- Larvae
- Maggots

Complex wounds require careful management and can present healthcare professionals with big challenges when trying to salvage limbs. Larval debridement therapy is a well established, highly selective method of both wound debridement and treatment of complex wounds. This article follows the case of a complex dehisced surgical wound where larval debridement therapy was utilised over a 2-week period and followed up with the application of topical negative pressure therapy. The aim of the treatment was not only to aid healing of the wound but also to prevent further limb amputation.

LAURA KATY BREEZE
Specialist Nurse, Skin Care Service, Liverpool Community Health, Liverpool, UK

Necrotic tissue within a wound can delay wound healing. It lacks the ability to fight against microbes, and instead provides them with the nutrients and environment to allow rapid multiplication and subsequent invasion into adjacent tissue (Stephens et al, 2014). Necrotic tissue can be removed using a range of methods, including surgical, sharp, mechanical, hydrosurgical, biosurgical (larval), autolytic and ultrasonic means. Not all of these methods are suitable, however, for complex wounds (Stephens et al, 2014).

LARVAL THERAPY

Larval therapy has a long history of use in the treatment of chronic and infected wounds. With the emergence of antibiotics in the 1940s, however, the practice of larval debridement therapy (LDT) declined. With the recent increase in cases of antibiotic-resistent strains of bacteria, for example methicillin-resistant *Staphylococcus aureus*, there has been growing interest in the use of LDT (Sherman, 2014). There is also evidence that larvae may have a role in biofilm disruption and preventing its formation (Nigam, 2013). Despite this, the use of LDT has often been seen as a last resort (Evans, 1997). However, evidence is now emerging to demonstrate that the method is safe, efficient and cost-effective (Bennett et al, 2013; Sherman, 2014)

The primary action of LDT is to debride the wound (Pritchard and Nigam, 2013). Larvae of the greenbottle fly *Lucilia sericata* are used to remove slough and dead or devitalised tissue from the wound bed, leaving the healthy granulation tissue (Telford et al, 2010). There is evidence to suggest that deep tissue debridement is possible, which may lead to more rapid removal of debris compared with many other non-surgical treatments (Sherman, 2014). Laboratory studies have shown that during the digestive process, larvae secrete digestive enzymes that liquefy necrotic tissue (Hobson, 1931; Vistnes et al, 1981; Cazander et al, 2013). It has been shown that larval secretions/excretions contain antimicrobial substances that kill microorganisms (Cazander et al, 2013; Nigam, 2013; Sherman, 2014). These substances have also been shown to promote the formation of plasmin and induce fibrinolysis, encouraging the breakdown of the fibrin slough that accumulates in chronic wounds. This keeps the wound free from infection and excessive inflammation, improving wound closure (van der Plas et al, 2008).

CASE STUDY

This LDT study is of a 77-year-old man who had undergone below-knee amputation of the left leg as a result of a clot that had occluded a popliteal aneurysm stent, resulting in a critical ischaemia. The patient was a regular golfer and had been playing 2 days prior to the operation.

The patient was being successfully treated for a post-operative wound infection by the district

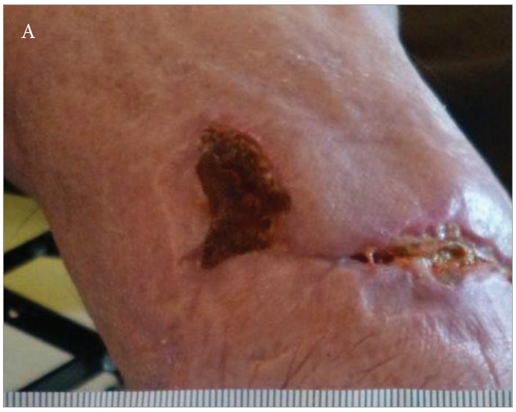

Figure 1. The patient's stump wounds at initial assessment, which were being treated with a silver alginate dressing: (a) wound A, with 100% eschar; and (b) wound B, with 90% thick slough and 10% exposed bone within a cavity

nurses when he fell out of his wheelchair directly onto the stump, opening the healing incision and exposing the bone. Following this, the patient was reviewed by his vascular consultant, who felt that an above-knee amputation would most likely be required. This would have meant a longer, more difficult rehabilitation, affecting the patient's quality of life, in addition to the cost of a further operation. The loss of a limb is devastating and cannot be underestimated. Even worse is the prospect of coming to terms with the loss of the lower leg only to be faced with further amputation. The patient was referred to the community tissue viability specialist team by the district nurses for assessment and support with management of the wound.

TREATMENT

Initial assessment

On the author's initial assessment, two separate wounds were present: wound A, 4 cm × 2 cm, which was 100% eschar; and wound B, 16 cm × 6 cm, which was 90% thick slough and 10% exposed bone within a cavity (*Figures 1a* and *1b*). Due to infection, the wounds were being managed with a silver alginate contact dressing, which was covered with a super-absorbent layer and secured with wool and crepe. The district nurses were changing the patient's dressings daily because of the level of exudate.

The author discussed with the patient the possibility of using LDT in order to biologically debride the wound and reduce healing time. He was provided with a Liverpool Community Health patient information leaflet on the use of maggots in wound healing, and the benefits and disadvantages were discussed. The patient was concerned as he was currently being treated for a wound infection and did not want to risk the infection becoming systemic. Assurances were given regarding the positive antimicrobial effects of LDT.

The ability of larvae to combat wound infections is widely reported (Van der Plas, 2008; Wang et al, 2010; Nigam, 2013; Sherman, 2013). It is possible that this is simply due to rapid debridement or ingestion and the subsequent destruction of wound pathogens as the larvae feed (Daeschlein et al, 2007; Mumcuoglu et al, 2012). Armstrong et al (2005) and Paul et al (2009) have explored amputation rates in patients with diabetic foot ulcers and found a statistically significant reduction in amputation rates in the LDT groups. When used effectively, LDT can reduce infection and amputation rates, as well as overall costs if implemented sooner rather than later (Tian et al, 2013).

Decreased wound healing time would reduce the length of time over which the district nurses would be visiting, along with the number of dressings that would be required. This would reduce inconvenience for the patient and reduce nursing workload and costs. Following in-depth discussion about LDT, the patient agreed to try the therapy and gave informed consent to the technique.

Initial application

The author returned the following day to commence LDT. The most commonly-used application method for larval therapy is the BioBag® (BioMonde). The larvae are sealed within

Figure 2. A week after larval application: (a) wound A, with healthy granulation; and (b) wound B, with reduced slough

a woven dressing pouch containing a small piece of foam that protects the larvae during the early stages of treatment (Ricci and Chadwick, 2014). Larval secretions penetrate through the net to the necrotic and non-viable tissue, which is liquified. Proteinaceous material then passes back the net and is ingested by the larvae. This method is well tolerated by patients and is relatively easy to apply, allowing the wound bed to be easily visualised without disturbing the debridement process too much.

The author applied two bags of LDT: BioBag 50 (2.5 cm × 4.0 cm) to wound A and Biobag 300 (12.0 cm × 6.0 cm) to wound B. She used zinc barrier cream to protect the peri-wound skin, then applied moist gauze, minimal wool padding and a crepe bandage. The BioBags were left in place for 4 days, with the district nurses visiting daily to change the outer dressings and check the viability of the larvae.

BioBags should be placed on the wound so the wound margin is covered where possible. Excess net should be folded back away from the peri-wound skin and a saline-moistened swab placed over the BioBag dressing, particularly if a wound is very dry (BioMonde, 2016). This should be secured with a secondary dressing to prevent slippage and ensure surface contact is maintained. The outer dressings need to be non-occlusive to ensure the larvae have access to the oxygen they need to survive (BioMonde, 2016). BioBags are available in a number of sizes (BioMonde, 2016):

- 50 (2.5 cm × 4.0 cm)
- 100 (5.0 cm × 4.0 cm)
- 200 (5.0 cm × 6.0 cm)
- 300 (12.0 cm × 6.0 cm)
- 400 (10.0 cm × 10.0 cm).

Week 1 after larval application

Two days following initial application, the patient was seen by a vascular nurse specialist in secondary care and the excellent progress of the wound was commented upon. The patient had been due to see the vascular consultant that week, but the appointment was cancelled due to this progress.

When the first BioBag was removed, the larvae were fat and mobile and the level of debridement could be assessed. Wound A now showed mostly healthy granulation tissue (*Figure 2a*), and a reduction in the amount of slough could be seen in wound B (*Figure 2b*). Due to the pharmacy having problems obtaining the second course of larvae, there was a delay in the second application. The district nurses had used a different pharmacy for the second prescription and the staff there were informed that they had to go through their supplier for a special order item, rather than contacting BioMonde directly for delivery within 24 hours.

Second application

The second involved application of larvae to wound B only. Again, the BioBag was left on for 4 days. On removal, there was minimal slough and the cavity had almost completely closed over (*Figure 3*). The surrounding skin was found to be highly excoriated and it emerged that the barrier cream, protecting the healthy tissue from the larval secretions, had not been applied since the first day of the second LDT application.

Figure 3. Wound B after the second larval debridement therapy showing minimal slough and reduced cavity size

Figure 4. Wound B 10 weeks after topical negative pressure to bring the wound edges together

After the second application

Following two courses of LDT (one course to wound A), the wounds had shown reduction in size and a change in wound characteristics. Wound A now had dimensions of 3 cm × 2 cm with 100% granulation tissue. Wound B now measured 13 cm × 4 cm with 90% granulation tissue, 5% slough and 5% bone. The cavity was now dramatically reduced.

Post-larval management

The method of wound management post-larval therapy was discussed with the patient and it was decided that the most effective option would be topical negative pressure, in order to bring the wound edges together through the promotion and formation of granulation tissue. This approach is designed to continue the healing progress and reduce, as far as possible, the factors that may delay wound healing.

Five days after the removal of LDT, therefore, topical negative pressure therapy was commenced and kept in place for 2 weeks before being discontinued by the vascular consultant. The patient was informed that further amputation was now highly unlikely. *Figure 4* shows the wound 10 weeks following topical negative pressure therapy.

CONCLUSION

The use of LDT reduced the wound healing time significantly. Within the space of 1 month, the patient had gone from daily dressing changes with four layers of dressing to a simple dry dressing, which was being changed three times per week. The patient was informed that further life-altering surgery would not be required, thus treatment was not only cost-saving, but also had a hugely positive effect on the patient's quality of life. WUK

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