Larval debridement therapy: vascular wound management
Larval debridement therapy in vascular wounds

INTRODUCTION

Lower limb ulcers (LLU) are a common manifestation of long-standing vascular disease and may be exacerbated by trauma or dependency. Ulcers can be grouped according to the underlying aetiology with approximately 76% due to venous disease, 22% due to arterial and 5% occurring as a complication of diabetes. In up to 20% of patients there is some crossover where a mixed picture is present.

Ulcers may be classified into acute wounds that heal within four weeks or chronic wounds that affect up to 1% of the adult population. LLU have significant impact on quality of life, especially of older adults and there is an increasing prevalence with age (Callum et al, 1987; Holloway, 1996).

LLU are a growing cost to the NHS, with each leg ulcer costing between £1,298 and £1,526 per year (Iglesias et al, 2004). If the estimated prevalence of leg ulcers in the UK is between 1.5 and 3 per 1,000 population then prevention, rapid healing and prevention of recurrence is paramount when resources are scarce (Palfreyman, 2008).

AETIOLOGY OF LEG ULCERS

Venous ulceration (Figure 1) is believed to be a complication of venous hypertension occurring after the development of valvular incompetence. This may be due to either a primary failure of the calf muscle pump or result secondary to another insult such as the development of a deep vein thrombosis (DVT) (Bem et al, 2004). In both cases this leads to venous stasis and hypertension, which in turn results in microcirculatory changes and localised tissue ischaemia (Browse, 1982; Coleridge Smith, 1988).

The majority of arterial ulceration (Figure 2) is caused by progressive atherosclerosis leading to ischaemia of the peripheral tissues. This may be divided into ischaemia caused by large vessel (macrovascular) or more distal vessel (microvascular) disease. Patients with diabetes may present with both macro- and microvascular disease and ulcers may be exacerbated by neuropathy and abnormality of the structure of the foot. Other causes are rheumatoid disease, syphilis, Yaws disease and malignancy. Often all of these conditions may stay quiescent until there is a stimulus such as a minor trauma causing an ulcer. This can then present challenges for wound healing as the failure to recognise the underlying disease pathology will increase the risk of an acute ulcer becoming chronic.

| Table 1: Risk factors for and clinical signs of lower limb ulceration |
|---|---|
| **Risk Factors** | **Presentation** |
| **Arterial** | Distal limb/foot/toes |
| Coronary heart disease | Punched out appearance |
| Cerebrovascular disease | Nocturnal pain |
| Cigarette smoking | Hair loss |
| Hyperlipidaemia | Hyperaemia |
| Hypertension | Claudication |
| Peripheral vascular disease | Pallor |
| Obesity | Impalpable or reduced distal pulses |
| **Venous** | Gaiter area |
| Varicose veins | Pigmentation |
| Previous DVT | Lipodermatosclerosis |
| Phlebitis | Eczema |
| Positive family history | Associated peripheral oedema |
| Symptoms of venous insufficiency such as night cramps | Oozing from surface |
| | Pain relieved by elevation of limb |
Successful leg ulcer management is complex with many patients presenting with recurrent episodes of ulceration that continue for years.

ASSESSMENT
The underlying pathology maybe identified through history taking, risk factors and presentation of clinical signs (Table 1, p1). This includes the holistic assessment of the individual as systemic disease such as anaemia, renal or cardiac failure may impede wound healing. A hand-held duplex identifies monophasic or biphasic waveforms suggesting arterial disease. Measurement of ABPI and ultrasound duplex imaging provide useful information of underlying arterial and venous disease.

CHALLENGES IN MANAGEMENT
Successful leg ulcer management is complex with many patients presenting with recurrent episodes of ulceration that continue for years, particularly in those of lower socioeconomic class (Callum et al, 1988; Grey et al, 2006). Treatment is best planned around severity of ulcer, medical comorbidities, quality of life, mobility and future prognosis. The role of the multidisciplinary team is crucial in providing a global care strategy for the long-term management of these patients (Bentley and Foster, 2007; Weller et al, 2013; Braun et al, 2014). In particular, this should focus on medical optimisation to improve potential for wound healing, involvement of wound care specialists as well as appropriate vascular surgical investigation and management.

MEDICAL MANAGEMENT
In arterial disease this focuses mainly on risk factor management including smoking cessation, lipid and hypertensive control and the use of antiplatelet agents (Hankey et al, 2006). It is important to consider the selection of medications with the risk of increasing peripheral oedema as a side effect in patients with underlying venous disease, especially where mixed disease is present. Diabetic control is a major factor and many patients have underlying, but as yet, undiagnosed diabetic disease. It is also important to treat any systemic disease such as an anaemia or renal dysfunction.

Wound dressing
LLU require regular attention with long-term strategies for dressing wounds. This is often in conjunction with the multidisciplinary team and 80% of care for this is provided in the community (Callum et al, 1985). Better outcomes are seen when this care is coordinated by tissue viability and podiatry specialist services (White et al, 2013). This allows a detailed knowledge of all the treatment modalities and promotes the sharing of professional skills and competencies within the team.

A venous ulcer with an adequate arterial supply, confirmed by either ABPI or arterial duplex ultrasound, should be managed with compression therapy using bandages or hosiery (SIGN, 2010). This attempts to combat venous insufficiency by improving venous return and reducing peripheral oedema, improving the diffusion of oxygen into the superficial tissues. There needs to be a balance between a dry, moist and wet wound environment and, as compression is frequently applied weekly, it is important to consider which primary dressing promotes an optimally moist wound environment.

Elevation of the limb acts to improve venous return and reduce swelling, but reduces the mobility of the patient and is often poorly tolerated, particularly where elevation can exacerbate pain secondary to chronic ischaemia.

Antibiotic therapy
Infection is always a risk in chronic ulcers. The use of antibiotics should be limited to ulcers where clinical signs of infection are present (SIGN, 2010). If infection rather than bacterial colonisation is suspected, swabs of the wound should be taken prior to administration of an approved antibiotic regimen and a date for review should be set. Some patients need admission to hospital where intravenous therapy can be initiated, and care can be coordinated with the intensity associated to the inpatient setting.
ADVANCED MANAGEMENT
Where arterial insufficiency is present, wound healing will be slow to progress due to reduced tissue perfusion. It is imperative that the limb is revascularised if there is underlying arterial disease. Patients are investigated using non-invasive duplex ultrasonography, magnetic resonance angiography, CT angiography or more invasive diagnostic subtraction angiography. Interventions may be radiological, as a hybrid approach, or surgical bypass using prosthetic or autologous bypass. If revascularisation is not possible due to very poor distal circulation then symptom control is important and, depending on disease progression and quality of life, amputation may be suggested.

Venous disease may also be treated, but traditionally this has been performed after ulcer healing to prevent recurrence. With the development of endovenous treatments, patients may benefit from early intervention to the superficial venous system to allow healing. Duplex scanning will identify arterial and venous disease levels with a focus on deep and superficial venous incompetence. Treatment of occluded or stenosed deep venous segments using innovative techniques such as venoplasty and stenting is now becoming more common.

WOUND DEBRIDEMENT
Wound debridement acts to remove necrotic, devitalised tissue from the wound bed in order to reduce bacterial loads and increase healing potential (Wounds UK, 2013). This can take the form of simple debridement as performed in the outpatient setting with wound dressings or other adjuncts (e.g. mechanical or larval debridement) to full surgical debridement where formal wound exploration and washout is undertaken in the theatre setting.

Major surgical debridement carries significant anaesthetic and operative risks where patients have multiple comorbidities. Careful planning should take place with consideration of the longer term outcome such as healing potential, need for re-operation and possible requirement for skin grafting.

The use of larvae in the debridement of wounds has had a popular resurgence since the 1990s with increasing use and small centre studies showing improved wound healing, effective removal of necrotic tissue and successful management of wounds affected by multi-resistant organisms (Dumville et al, 2009; Rafter, 2013; McInnes et al, 2013). It provides a useful alternative when rapid removal of devitalised tissue is required and surgical debridement is not an option (AWTVN, 2013). Although the decision to use larval debridement therapy (LDT) should be taken by a specialist practitioner with the appropriate skill, knowledge and experience, it can be safely applied by any qualified healthcare practitioner (see p8–11).

First, wound assessment should be carried out to ensure the selected wound is appropriate for LDT. This should be a moist, sloughy wound with necrosis/slough present at the wound base. Second, appropriate vascular assessment should be completed to ensure the wound is not in close proximity to a large vessel and does not communicate with internal body cavity or organs. There should be no increased risk of bleeding or presence of coagulopathy.

Patient assessment should be undertaken and informed consent sought. Provision of patient information leaflets can help support clinician-led discussion. Importantly, patients should be counselled regarding the sensation of the presence of larvae, often experienced as itching (Spilsbury et al, 2008). Increased pain at the wound site can occur in up to 25% of cases and patients may also note a malodourous smell leaking from the wound due to liquefaction of necrotic tissue and vaporisation of products of putrefaction (Sherman et al, 2001). These factors should be discussed and monitored during therapy with appropriate consideration given to augmenting oral analgesic regimens.
CONCLUSION

Lower limb ulceration due to long-standing vascular disease is costly and complex to manage. A structured managed approach focuses on optimising the wound environment for healing and involving the multidisciplinary team. Debridement is an essential component of wound management and methods such as LDT should be considered for rapid debridement of devitalised tissue, for example, when a surgical approach is not clinically indicated. Early diagnosis and intervention can help to reduce infection and amputation risk in patients with lower limb ulceration.

REFERENCES


Evidence for larval debridement therapy in vascular wounds

INTRODUCTION
Recent publications (Strohal et al, 2013; Wounds UK, 2013) have indicated the importance of debridement as an initial and ongoing element of wound management. Healthcare professionals who manage wounds need to understand the principles of wound debridement and be able to offer effective care using a number of different debridement techniques. This article explores the role of, and supporting evidence for, larval debridement therapy (LDT) in the management of vascular wounds, focusing on arterial and venous ulcers.

CRITICAL LIMB ISCHAEMIA
Decisions relating to wound debridement are central to the management of a patient with critical limb ischaemia and associated tissue loss or necrosis. Patient outcome, quality of life and limb salvage, particularly when non-reconstructive vascular disease is identified, is ultimately dependent on the clinical effectiveness of wound management and infection and pain control.

In patients with peripheral vascular disease, full assessment of the circulation should be performed prior to debridement to determine the healing potential as healing will not occur in the presence of severe arterial disease (Contreras-Ruiz, 2003). Multidisciplinary team decisions must be made to ensure that debridement is required and timing of each intervention is optimal (FDUK, 2014).

There are reported cases in the literature (Igari et al, 2013; Rafter, 2013; Campbell and Campbell, 2014) that support timely and effective wound management, including LDT, in patients with lower limb arterial ulceration. Steenvoorde et al (2007) reviewed care in 101 patients with 117 ischaemic wounds. Most wounds were worst-case scenarios, in which LDT was a treatment of last resort. The authors concluded that older patients and patients with chronic limb ischaemia or deep wounds are less likely to benefit from LDT as are those with septic arthritis, but that for the majority of patients (67%) wound improvement or complete healing was observed. In a single case study, the authors suggest that LDT may contribute to improved local perfusion in critical limb ischaemia (Maeda et al, 2014). Further, Jukema et al (2002) suggest that, in selected cases, LDT may be an amputation-sparing intervention.

Dry hard eschar and dry digital ischaemia can, for some patients, be a safe and tolerable outcome. The primary aim when managing wounds of this type should be maintenance of desiccated necrosis (hard eschar) while the multidisciplinary team establish a treatment plan with individualised goals of care. If the wound becomes moist (wet gangrene) with an associated risk of infection then early intervention may be necessary, particularly in the presence of spreading sepsis. In such situations urgent sharp or surgical debridement or minor amputation with appropriate broad-spectrum antibiotic cover is necessary as part of infection management (Lipsky et al, 2012).

For the majority of patients either peripheral perfusion is considered adequate for wound healing or, following endovascular or open vascular intervention, pulsatile blood flow to the ischaemic limb is restored. Such patients require active wound management with rapid reduction in necrotic tissue load combined with preservation of viable underlying tissues. Patients benefit from a planned programme of debridement, frequently combining initial limited sharp debridement, eschar rehydration and softening, and LDT or mechanical debridement. The goal is a healthy granulating wound bed with minimal exposure of tendon, joint or bone (Wounds International, 2013). In our unit such a plan is often integrated with negative pressure wound therapy (NPWT), with or without antimicrobial instillation therapy.

One of the key issues relating to debridement in patients with ischaemic ulceration is to ensure adequate analgesia and that patients are able to tolerate elevation of their legs. Elevation reduces limb oedema and wound exudate, helps prevent periwound skin maceration and can improve the effectiveness of larval therapy. LDT is reported by some patients to be painful, particularly in the presence of arterial disease. It is therefore necessary to titrate pain relief throughout the period of treatment (Mumcuoglu et al, 2012) and reduce any patient anxiety (Menon, 2012).
One potential advantage of the use of LDT in the management of gangrene associated with severe peripheral arterial disease is in the treatment of osteomyelitis. Baer’s work, originally published in 1931 and reprinted in 2011, suggests a role for larvae in treating chronic osteomyelitis. We have found larval debridement to be particularly useful when dealing with heel ulceration, where the os calcis may easily become exposed (see Case 3, p13).

VENOUS ULCERATION

For the majority of patients with lower limb venous ulceration, high compression multicomponent bandage systems combined with simple non-adherent dressings are sufficient for autolytic wound debridement to occur. For some patients with more complex aetiology or with long duration or infected wounds, debridement can be slow or there is a continuous re-accumulation of soft eschar and slough. In such situations active debridement to accelerate wound healing may be more appropriate. In our unit, LDT has been used successfully in this situation and has been combined with carefully applied compression. The type of compression should be selected so as not to kill the larvae by occlusion or by pressure. In practice, the foam component of the BioBag prevent the larvae from being crushed and experience has demonstrated that larvae are not killed by compression bandaging.

The VenUS II study, which compared the clinical and cost-effectiveness of larval therapy with debridement using a hydrogel concluded that LDT significantly reduced the time to debride chronic venous and mixed venous/arterial leg ulcers when compared with hydrogel. However, the overall findings suggested no difference between LDT and hydrogel in terms of health benefits or cost (Dumville et al, 2009; Soares et al, 2009). An earlier study by Wayman et al (2000) did, however, suggest that LDT is more effective and significantly less expensive than hydrogel in the debridement of sloughy venous ulcers. A more recent randomised controlled trial comparing LDT with hydrogel in 64 patients with venous or mixed aetiology leg ulcers found that LDT led to significantly fewer dressing changes and debrided wounds faster than a hydrogel (Mudge et al, 2014). However, patients in the LDT arm did experience more ulcer-related pain or discomfort than those in the hydrogel arm (Mudge et al, 2014).

A recent economic evaluation comparing available debridement interventions found LDT to be more cost-effective than comparator debridement therapies (Bennett et al, 2013), while Wilasrusmee et al (2014) concluded from analysis of a variety of wound types (including venous leg ulcers) that LDT is significantly better for wound healing and more cost-effective than conventional wound therapy. Shortened healing times were also reported by Sun et al (2014). Both Petherick et al (2004) and Spilsbury et al (2008) found the concept of larval therapy to be broadly acceptable to patients with venous leg ulceration.

VASCULITIS AND PYODERMA GANGRENOSUM

Cazander et al (2013) suggest that larval secretions contain molecules that not only accelerate healing but also reduce chronic inflammation by reducing bacterial infection. This is supported by Nigam (2013) who reports on recent research which shows that larval secretions may have an inhibitory effect of harmful proteases, with increased production of anti-inflammatory cytokines. Experience by Renner et al (2008) reports poor survival of larvae when applied to two patients with pyoderma gangrenosum. However, Rozin et al (2011) reports successful combination of larval therapy with immunosuppression and Biscoe and Bedlow (2013) have used LDT to successfully treat warfarin-induced skin necrosis. Contreras-Ruiz (2003) states that LDT may be used with caution in inflammatory conditions; however, more detailed research is required to inform practice in these patients.

CONCLUSION

There is evidence to show that larval therapy used on sloughy or necrotic wound tissue is an efficient method of wound debridement in a variety of vascular wounds. Timing of debridement needs to be coordinated with other treatments and this is vital to maximise patient outcomes and prevent complications. When used in selected patients LDT can be both clinically and cost-effective.
“Jukema et al. (2002) suggest that, in selected cases, LDT may be an amputation-sparing intervention.”

**REFERENCES**


Biscoe AL, Bedlow A (2013) Warfarin-induced skin necrosis diagnosed on clinical grounds and treated with maggots debridement therapy. BMJ case reports. Available from: http://bmj.co/1ua0N3b


There are two methods of application of larval therapy currently available: loose or free-range larvae and Biobag dressings. The most commonly used mode is the Biobag (Figure 1, p9). The larvae are sealed within a finely woven polyester net bag, which is available in different sizes. The bag contains one or more small pieces of foam, which protect the larvae during the early stages of treatment. Larval secretions penetrate through the net bag where it liquefies the non-viable tissue which is then ingested by the larvae. Each application can be left in place for up to four days. Loose larvae are applied directly to the wound bed and retained within a special dressing system, either a flat net, sleeve or boot, for a maximum of four days.

Free-range larvae can be an effective choice where the wound has an irregular border, as the larvae are free to move across the wound bed reaching ‘jagged’ wound edges, common in many vascular wounds. They are also useful where undermining is suspected or where the extent of the wound is unknown. Free-range larvae with the sleeve or boot retention system may also be used for extensive circumferential arterial or venous leg ulcers. For effective debridement, nets should be sized to overlap the whole wound and boots and sleeves should extend beyond the length of the wound. Care should be taken during application to minimise the risk of escapees; occasionally the dressings may come loose, especially if left in place for more than 48 hours, and will need to be secured appropriately (Sherman, 2009).

The Biobag is the preferred method where the surrounding skin is unhealthy or not intact, for patients with bleeding tendencies, or with wounds close to large vessels or natural orifices.

Other advantages to using the Biobag include:
- The larvae are enclosed in the net bag on application and throughout the duration of the therapy, which makes the Biobag a very simple and practical option.
- Using ‘contained’ larvae in this way can also decrease clinician’s discomfort, because they can apply and remove the dressings without handling the larvae directly (although the clinician should check if the larvae are still viable during the treatment).
- The wound can be observed during treatment, which can be useful if close monitoring is needed (Figure 2, p9).
- The Biobag may also appear to reduce the risk of patient discomfort, because the larvae contained within a bag cannot move over exposed nerves (Sherman, 2009).

Clinicians should consider certain factors when considering which method of application to use including the nature of the wound and clinician’s and patient preference. Table 1 summarises key considerations. The manufacturer’s size guide can be used to select Biobag size and the free-range calculator can assist in deciding the number of pots of loose larvae that will be needed. The calculation depends on the size of the wound and the thickness of the slough or non-viable tissue to be debrided.

<table>
<thead>
<tr>
<th>Loose larvae</th>
<th>Biobag dressing</th>
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<tbody>
<tr>
<td>Wound with irregular borders</td>
<td>Bleeding tendencies</td>
</tr>
<tr>
<td>Undermining is expected</td>
<td>Wounds close to large vessels or natural orifices</td>
</tr>
<tr>
<td>Extent of wound unknown</td>
<td>Poor periwound skin</td>
</tr>
<tr>
<td>Extensive circumferential leg ulcers</td>
<td>Patient preference for contained larvae</td>
</tr>
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<td>Previous clinician experience</td>
<td>Previous clinician experience</td>
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</table>
Early intervention with LDT in vascular wounds, using larvae as a first-line treatment (see case 1 p11), can contribute to improved patient outcomes: for example, faster debridement times and wound bed preparation; faster wound healing times; and reduction in wound pain and odour. LDT may also reduce the need for amputation (Parnes and Lagan, 2007).

**PRACTICAL TIPS FOR APPLYING LARVAL THERAPY**

- Decide if free-range larvae or Biobag dressing(s) are appropriate for the wound.
- Use the sizing guides and calculator available to determine the correct size of Biobag(s) or pots of larvae to order/use.
- If free-range larvae are used, choose a net for single wounds that are easy to dress or affect smaller areas; use a sleeve (open at both ends) for circumferential ulcers; a full boot for wounds situated on the feet, hands, stumps and a half boot for toes.
- When using a flat net, a hydrocolloid dressing can be applied to border the wound; a strong tape is then used to secure all edges of the net. A hydrocolloid dressing should be used for the creation of the retention border for a boot or sleeve.
- Pre-moisten the gauze and tip the free-range larva onto it to make application easier.
- Avoid using wound products that contain propylene glycol (e.g. some hydrogels) for 48 hours prior to application of larvae. These products have been reported to affect the survival of the larvae.
- All larvae must be applied by the expiry date. This is usually the day after delivery. For optimal results apply on the day of delivery.
- Use the barrier cream provided and hydrocolloid or zinc paste/bandage. An alternative barrier cream can be used if preferred as long it protects the surrounding skin from powerful proteolytic enzymes within larval secretions. A thin layer of the barrier cream should be applied; too much product can block the pores in the net. Reapply if needed when the outer dressings are changed.
- Fold or double back the Biobags to avoid contact with the periwound skin.
- Apply pre-moistened gauze (saline soaked then wrung out gauze) over the larvae/Biobag, then apply dry gauze (Figure 3) and secure. An occlusive or film-backed dressing cannot be used as the larvae will suffocate. Advise the patient to avoid direct pressure to the dressing or the larvae may be squashed and will not survive.
- LDT can be applied under compression bandaging using a breathable system (Mudge et al, 2014)
- Expect exudate to be reddish brown in colour with a smell of ammonia. Reassure the patient and staff looking after the patient that this is normal.
- Outer absorbent dressings or retention bandages should be checked daily either by nursing staff or tissue viability nurse. The larval secretions that break down any non-viable tissue into a liquid will initially make for a wetter environment requiring more frequent dressing changes.
- Measure and photograph the wound according to local protocols to aid communication with the multidisciplinary team and to document the progress of the intervention.
- The larvae can be left on the wound for up to four days. Review the wound 24 hours before planned removal to determine if a second application is needed and to agree the ongoing wound management plan.
- On removal, double bag and dispose of as per local clinical waste protocol.

**MINIMISING PAIN**

Rafter (2013) stated that debridement should be as non-traumatic and painless as possible for the patient. Patients with lower limb ulceration often complain of pain (Stephen-Haynes, 2007) and that using LDT in such wounds can increase pain. LDT-associated pain or discomfort is reported in 5–30% of wounds treated (Sherman, 2009). Analgesia can be planned in advance to minimise procedural pain in patients who report wound-related pain before receiving larval therapy.
Patients can also be reassured that if the pain cannot be managed effectively, they have the option of discontinuing the treatment.

**IMPROVING TOLERABILITY**

Patients’ perceptions of larvae as a wound management treatment and their acceptance for their use may also pose a challenge. This has been referred to as the ‘yuck factor’. When talking to patients and clinicians, choose words carefully to describe how larvae debride a wound and promote the benefits in a confident and assured way. This can have a positive effect on both patient and staff perceptions of LDT (Sherman, 2009). In one study, Spilsbury et al (2008) reported that the majority of participants stated that they would consider larval therapy, irrespective of the method of application.

**POST-TREATMENT APPROACHES TO SUPPORT LARVAL THERAPY**

The primary action of larval therapy is to debride the wound, removing slough and dead or devitalised tissue from the wound bed (Pritchard and Nigram, 2013). In addition, there is evidence to suggest that the larvae can also promote other activities that contribute to wound healing (Sherman, 2014). Although this therapy may be able to promote tissue regeneration and restore normal healing processes (Sherman, 2014), larvae will not heal the wound and additional therapies are needed for complete closure (Keller, 2011).

To optimise wound healing potential, adequate perfusion to the wound bed will be needed, so where possible, ischaemic problems should be managed by revascularisation to restore blood flow (Gabrielle, 2012). However, for higher-risk patients or where wounds are poorly perfused and revascularisation is not possible, there are treatments available that do not require further operative procedures. One treatment option is negative pressure wound therapy (NPWT) to assist wound closure. In poorly perfused vascular wounds, NPWT, even when used for just a short period, can allow monitoring of the wound to assess the viability of the tissue (WUWHS 2008). NPWT can also be used to prepare the wound optimally prior to skin grafting and afterwards to assist the taking of the graft (WUWHS, 2008). This combined approach is designed to continue the healing process and reduce, as much as possible, complications that may delay healing.

Using LDT first line, as part of a staged approach, can assist wound bed preparation and optimise healing in patients with lower limb ulceration.

**REFERENCES**


CASE 1: LDT ON A DONOR LEG WOUND FOLLOWING CORONARY ARTERY BYPASS GRAFTING

BACKGROUND
This patient was a 67-year-old gentleman who underwent coronary artery bypass grafting (CABG) during which a vein was harvested from his left leg.

Approximately 3 weeks after surgery, the left donor leg wound had begun to dehisce due to a wound infection. The patient had a complex medical history including insulin dependent diabetes and peripheral neuropathy. He was also extremely concerned about losing his leg, as a family member with a similar medical history had undergone leg amputation due to wound infection. The presence of pre-existing peripheral vascular disease greatly increases the risk of complications following saphenous vein harvest and patients with coronary artery disease often have co-existing peripheral vascular disease, especially patients with diabetes (Treadwell, 2003).

TREATMENT
Larval therapy was selected for fast debridement, wound bed preparation and a reduction in the bacterial burden. Verbal consent was given by the patient.

On the day of application the wound was almost 100% slough (Figure 1). Two Biobags were applied and covered with damp, saline soaked/wrung out gauze, dry gauze and secured with a light tubular bandage. Gauze outer dressings were changed daily and on the fourth day the larvae were removed. The wound bed was 100% bright red with evidence of healthy granulation tissue (Figure 2).

Negative pressure wound therapy (NPWT) (V.A.C.® Therapy, KCI) was applied after debridement to close the wound, which was achieved two months later (Figure 3).

OUTCOME
One application of larvae was sufficient to fully debride the wound, leaving a clean wound bed and optimal wound environment for healing. From previous experiences of using conventional wound dressings to debride similar wounds, the time to debride the wound was significantly reduced using Biobag dressings.

This case study demonstrates that early application of larvae on a lower limb vascular wound can reduce wound bed preparation time, with the potential to reduce time to healing. This can impact on nursing time and resources as well as patient wellbeing.

CASE 2: LDT ON VENOUS LEG ULCER PRIOR TO COMPRESSION THERAPY

BACKGROUND
This patient was a 62-year-old gentleman with a chronic venous ulcer. He was admitted as an emergency with sepsis due to an infected and necrotic venous ulcer on his right leg.

This gentleman had developed a venous ulcer secondary to venous insufficiency. This has responded in the past to compression bandaging, but once healed the patient has been non-concordant with maintenance compression hosiery. He was recently admitted acutely unwell with an infected venous ulcer. This responded well to a short course of antibiotics and bed rest with elevation. The wound was necrotic and required debridement. The necrotic layer appeared to be thick and the team were keen to debride the wound promptly to allow the application of 2-layer compression bandaging and discharge under the care of community tissue viability and district nursing with a shared care plan.

TREATMENT
The options for debridement were considered within the multidisciplinary team (MDT). Surgical debridement was an option but required an anaesthetic as the leg was sensate. The patient was not medically fit and, although a safe option, exposed him to an unnecessary risk of a general/spinal anaesthetic. Hydrogel debridement was considered but it was felt that this would require repeated applications. The option of larval therapy was discussed with the patient who agreed to this course of action. LDT was requested and Biobags ordered and applied the following day.

On the day of application the wound was almost 100% slough (Figure 1). Two Biobags were applied and covered with damp, saline soaked/wrung out gauze, dry gauze and secured with a light tubular bandage. Gauze outer dressings were changed daily and on the fourth day the larvae were removed. The wound bed was bright red with evidence of healthy granulation tissue (Figure 2).

OUTCOME
One application of larvae was sufficient to effectively and efficiently debride the wound, leaving a clean wound bed and optimal wound environment for healing with the application of compression bandaging. Compression was not applied at the same time as debridement, which is possible, as it was felt that a period of high-leg elevation would benefit the patient. The patient is now in 2-layer compression bandaging and the ulcer is responding well.

This case study demonstrates that appropriate early debridement options agreed within a MDT allows efficient use of resources such as inpatient beds and the costs associated with this.
CASE 3: LDT ON CATEGORY IV HEEL PRESSURE ULCER

BACKGROUND
This elderly lady developed a Category IV heel pressure ulcer while in her own home. She had been suffering with rest pain, was unable to sleep in bed at night and instead was sleeping in a chair. This resulted in increasing leg and foot swelling.

She was admitted to hospital with sepsis and was noted to have offensive malodourous tissue loss. Her os calcis was palpable, but there was no evidence of osteomyelitis on X-ray (Figure 1). Arterial imaging indicated that reconstructive vascular intervention would not be possible. It was felt that amputation would be required should there be any further deterioration in her heel.

TREATMENT
A treatment plan was established focusing on heel offloading to relieve pressure, pain management to optimise her quality of life, and debridement to reduce the risk of infection and osteomyelitis by rapidly reducing eschar, slough and bacterial load while preserving the periosteum.

She was reviewed by the pain management team and provided with appropriate medication that controlled her wound pain, improved her quality of life and allowed her to sleep in bed. This in turn reduced her peripheral oedema.

Larval therapy was used to achieve initial debridement. Sharp debridement was considered, but the nature of the necrosis and undermining was such that the extensive necrosis could not be easily removed without anaesthetic. Free-range larvae were selected to ensure access to undermined areas and removal of necrosis.

After the initial treatment with larval therapy the wound improved (Figure 2). However, the sloughy tissue remained difficult to remove with sharp debridement and it was decided to treat the wound with a further application of Biobag larvae. This resulted in a further reduction in sloughy tissue (Figure 3).

OUTCOME
Conventional dressings were used following larval therapy, with further improvement in the wound (Figure 4), which went on to heal.