Maggots ‘n’ chips: a novel approach to the treatment of diabetic ulcers

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It is estimated that there are approximately 1.4 million people with diabetes in the UK. According to Gordois et al (2003), approximately 15% of this population will develop at least one foot ulcer during their lifetime, and of these a significant proportion (possibly in excess of 15%) will result in an amputation of the toe, foot or leg.

The management of diabetic ulcers presents a particular problem to the healthcare professional, as these wounds are easily infected and generally show little propensity to heal because of the associated vascular disease. A recent systematic review of the treatment options for infected diabetic foot ulcers (Nelson et al, 2006) provides little useful practical advice on the treatment of this condition; the authors concluded that ‘there was no strong evidence for recommending any particular antimicrobial agent for the prevention of amputation, resolution of infection or ulcer healing’.

In the community, treatment of diabetic ulcers often involves the use of many different dressings, variously designed to promote debridement, combat infection, or facilitate healing. Regrettably, in many cases, despite the best efforts of all concerned, these treatments are unsuccessful and the patient has little option but to accept an amputation.

One somewhat unconventional form of treatment that has been used with some success involves the use of sterile maggots to remove necrotic tissue and combat infection. A number of case reports and small-scale studies have been published that describe the use of this therapy in the treatment of the diabetic foot and most of these papers describe how the maggots are placed directly on the wound and covered with a piece of nylon net to prevent them from migrating onto the surrounding skin.

Although treatment outcomes can be impressive with this—the so-called ‘free-range’ technique—the use of maggots is sometimes avoided or rejected by health-care staff for aesthetic reasons—the so-called ‘yuk’ factor. This is particularly true in the community where patients or their partners have concerns, generally totally unfounded, that maggots will escape and potentially cause a plague of flies in their house!

In an attempt to address this problem, maggots have in the past been presented in a simple net bag resembling a tea bag which overcomes most of these aesthetic objections, but outcomes with this presentation have in many instances been disappointing (Thomas et al, 2002).

Recently, however, a new dressing has been developed that combines the clinical benefits of ‘free-range’ maggots with the ease of use of a conventional dressing. This new product, called the LarvE Biofoam™ Dressing consists of a pouch containing maggots and large numbers of tiny foam chips which provide an environment within the pouch that is ideally suited to the maggots’ development. The foam chips within the dressing also provide a significant fluid-handling capability for dealing with wound exudate.

This case study describes the first reported use of this new dressing in the management of an infected diabetic foot wound in the community.

Medical History
The patient, Mr T, is a 79-year-old gentleman who was diagnosed with type 2 diabetes in 1991. In addition to his diabetes, he also has ischaemic heart disease, peripheral vascular disease, hypertension, and anaemia of unknown origin.

Following a period of hospitalization, Mr T underwent a below-knee amputation of his right leg for an infected foot ulcer in February 2006. The amputation site healed well, but while in hospital he also developed an ulcer on his left hallux.

Arterial surgery was performed to improve the blood supply to the affected limb but despite this intervention, the toe became gangrenous and had to be amputated. He was discharged from hospital into the care of the primary care team on 5 May 2006 following a five-month period as an inpatient.

ABSTRACT
The management of diabetic ulcers presents a particular problem to the healthcare professional as these wounds become easily infected and often show little propensity to heal, leading in many cases to an amputation. The application of sterile maggots in a new presentation called the Biofoam Dressing transformed a longstanding MRSA infected amputation site into a clean granulating wound in one treatment. Further multiple applications of maggots to the newly cleansed wound were associated with the rapid development of granulation tissue and the elimination of the MRSA. Based upon our experience, it is proposed that, in the absence of effective conventional treatments for infected diabetic foot ulcers, the use of this technique should be considered as a first line therapy for all such wounds.

KEY WORDS
Diabetic ulcers • Infection • Debridement • Maggots
Following his discharge, inspection of the wound revealed an amputation site that was filled with slough and which, upon bacteriological investigation, was found to contain a prolific growth of methicillin-resistant *Staphylococcus aureus* (MRSA). At this stage the wound was being dressed with the silver hydrofiber dressing AQUACEL Ag, but in an attempt to promote debridement this was changed to the honey-based products Mesitran ointment and Activon Tulle.

Despite this change in therapy, the wound showed little evidence of improvement and a further swab identified that the wound was still infected with MRSA, which was shown to be sensitive to tetracycline.

A course of oral oxytetracycline was initiated, but as the wound continued to deteriorate Mr T very reluctantly agreed to a second hospital admission on 23 May, when the wound was assessed. A second below-knee amputation was advised, which the patient refused. Mr T was therefore discharged a second time on 26 May for palliative care.

At this time Mr T’s diabetes was being controlled with metformin and gliclazide and he also received simvastatin, ramipril, spironolactone, frusemide, ferrous sulphate and omeprazole for his other medical conditions. Because of wound-related pain in his left leg he was prescribed morphine sulphate (60mg twice daily), gabapentin (600mg three times daily) and paracetamol (1000mg as needed up to four times daily).

The community nursing staff, who visited on alternate days, continued to dress the wound with honey and Activon Tulle as before, but without any noticeable success as the wound, which was extremely painful, remained sloughy and MRSA positive. Doses of opiates were increased to provide pain control but Mr T’s blood glucose became unstable and he had episodes of feeling very unwell and feverish, although he remained largely afebrile.

It was at this point that maggot therapy was first considered as a treatment of last resort, simply to clean up the wound and reduce the unpleasant odour that was having a negative impact on the lives of the patient and his family. There was little expectation at this time that the maggots would impact significantly upon the healing process.

**Maggot treatment**

Mr T was first assessed for maggot therapy on 29 June 2006. At this stage the wound, which was producing a copious, offensive-smelling, blood-stained discharge, was approximately 5cm x 3cm, and almost completely covered with necrotic tissue (**Figure 1**).

Historically this wound would probably have been dressed with free-range maggots, but on this occasion the decision was made to use the new Biofoam dressing. This was easily applied as shown in **Figure 2**, and covered with an absorbent pad which was held in place with conventional bandages. The dressing was left in place for four days, although the outer absorbent layers were changed on a daily basis.

At the end of this time the dressing had absorbed a significant quantity of exudate and the maggots inside had increased considerably in size (**Figure 3**).

When the Biofoam dressing was removed, a remarkable
change in the condition of the wound was immediately
apparent. Virtually all the necrotic tissue had been removed
revealing a deep wound in which exposed bone was clearly
visible although much of the base of the wound was now a
healthy red colour with some evidence of new granulation
tissue beginning to form (Figure 4).

In the past, the tendency might have been to discon-
continue maggot therapy at this stage in favour of a more
conservative treatment, but given the poor response of
the wound to the dressings already used and the pos-
sibility that the wound might reslough if the MRSA had
not been completely eliminated, the decision was made
to continue maggot therapy to prevent recurrence of
the infection.

When maggot treatment was first initiated, it was as a
form of palliative care designed to combat the MRSA
infection, alleviate pain and eliminate the very offensive
odor emanating from the wound; given Mr T’s poor
physical condition, it was not anticipated that his wound
would ever actually heal. To the surprise of all involved in
Mr T’s care, however, obvious signs of healing were detect-
ed within the wound at an early stage of treatment and
therefore the decision was taken to continue the therapy
for as long as his wound continued to make significant
progress towards healing. Further applications of maggots
were therefore made twice weekly, and on each occasion
the Biofoam dressing was removed, a significant improve-
ment was noted as the wound progressively decreased in
depth. The wound remained free of infection and a swab
taken on 27 July showed no sign of MRSA.

Maggots’ secretions contain powerful proteolytic
enzymes which are responsible for their remarkable wound
cleansing activity and if these are allowed to spread onto
unprotected peri-wound skin they can sometimes cause
superficial damage by removing the keratinized (dead)
epidermal layer (Thomas et al, 1996). Some evidence of
this was visible on Mr T’s second toe at the first dressing
change. As each subsequent Biofoam dressing was applied,
therefore, great care was taken to protect the surrounding
skin by the addition of a zinc paste bandage around the
toes and other vulnerable areas (Figure 5).

By 14 August (Figure 6) a substantial portion of the
wound had become filled with new granulation tissue
and there was clear evidence of new epithelium forming
around the wound margin. Ten days later, on 24 August,
examination of the wound confirmed that new epithelium
was continuing to form and there was clear evidence of the
new tissue attempting to migrate over the exposed bone
(Figure 7).

By 25 September, less than 3 months after the initiation
of maggot therapy with the new Biofoam Dressing, most
of the wound was covered with new epithelium, with
the exception of a small area of healthy granulation tissue
about 2cm² in area (Figure 8). Mr T was awaiting an ortho-
paedic referral for removal of the metatarsal head visible
in Figure 8, when on 13 November it spontaneously came
away from the foot, leaving a clean, healthy cavity which is
now progressing to healing.
CASE STUDY

Discussion

The revival of maggot therapy (also known as larval therapy) began in the United States in 1983 when Sherman et al used maggots for treating pressure ulcers in people who had suffered spinal cord injuries (Sherman et al, 1995). This was followed by further reports of the use of larval therapy in podiatry (Stoddard et al, 1995) and recurrent venous ulceration (Sherman et al, 1996). Sterile maggots under the brand name of LarvE were introduced into Europe in 1995 by the Biosurgical Research Unit, now ZooBiotic Ltd (Thomas et al, 1997). Since then over 20 million maggots in 64,000 dosage units have been supplied to an estimated 30,000 patients in some 3300 centres throughout the UK and beyond.

Well over 200 papers have been published on maggot therapy, and among these many of these contain largely anecdotal information, some report the results of multiple case studies and others clinical trials. Together these publications make reference to some 7000 patient treatments and as such represent a significant body of evidence, which is overwhelmingly positive. Some of these publications describe studies which demonstrate the ability of maggots to combat MRSA both in-vitro (Bexfield et al, 2004) and in-vivo (Wollf and Hansson, 1999; Thomas and Jones, 2000), while other describe how maggot therapy has prevented the need for amputations (Namias et al, 2000; Korb et al, 2002).

A recently-published review of the wound care literature strongly suggests that maggots represent an extremely cost effective option for the treatment of infected and necrotic wounds, which could save the NHS in excess of £200 million each year if the technique were to be adopted as the treatment of choice for these indications. These financial benefits are based on the savings that come from the marked reduction in treatment time for maggots treated wounds compared with conventional therapies (Thomas, 2006).

It has been suggested that the direct cost of an amputation is in the order of £30,000–£60,000 and the cost of 3 years aftercare following amputation is likely to be around £43,000–£63,000 (Lefebvre, 2005). In the context of these figures, the cost of maggot therapy to cleanse an infected sloughy lesion in podiatry or their reported ability to stimulate the formation of new granulation tissue certainly appears to suggest that the presence of the maggots had a beneficial effect on the condition of the wound. This is even more remarkable given the patient’s medical history.

In the light of the lack of evidence for the effective treatment of infected diabetic foot ulcers identified in the recent systematic review (Nelson et al, 2006), we propose that the results of the present study suggest that the use of maggots in general, and the new Biofoam Dressing in particular, could provide clinicians with an effective first-line solution to the problem of managing this distressing and debilitating condition. We are aware of no other non-surgical treatment that might be expected to achieve the results obtained in this case, transforming a heavily infected necrotic lesion into a clean granulating wound within 4 days and approaching closure in 3 months.

Anecdotal reports, however, suggests that if maggot therapy is continued after debridement has been achieved, the continued presence of the maggots within the wound appears to prevent this deterioration and enable the wound to progress towards healing. It is not clear if this effect is due to the ability of the maggots to prevent further infection or their reported ability to stimulate the formation of granulation tissue by the production of growth promoting substances, as suggested by Prete (1997).

This is the first reported instance of which we are aware in which maggots have been repeatedly reapplied to a newly cleansed wound specifically to facilitate healing, and the results certainly appear to suggest that the presence of the maggots had a beneficial effect on the condition of the wound. This is even more remarkable given the patient’s medical history.

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