Maggot Debridement Therapy

A Primer

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Intractable lower-extremity wounds are a commonly encountered challenge to physicians.1-3 The medicinal use of larvae, or maggot debridement therapy, for treatment of these wounds has steadily increased in the past 10 years, particularly in progressive, high-volume wound-care centers in Europe and Asia. To date, the use of larvae, particularly the larvae of the green blow fly *Phaenicia sericata*, to assist in the treatment of wounds has been much less common in the United States. This article briefly discusses the history of maggot debridement therapy and presents a method of using maggot debridement therapy in the treatment of diabetic foot wounds.

**History of Maggot Debridement Therapy**

The medicinal use of maggots has a very long history, with the introduction of this form of treatment possibly dating back thousands of years. Ancient records suggest that the Maya Indians of Central America used dressings of beef blood set in the sun to heal superficial wounds. The Ngemba tribe of New South Wales, Australia, also commonly used maggot therapy for gangrenous wounds.4 Despite these sporadic reports of medicinal use of maggots, use of maggot debridement therapy did not become widespread in the West until the mid-19th century, when it became popular in France and the United States.1,5,6

Baer,7 in 1931, first documented the intentional use of maggots for treatment of skin infections. Maggot debridement therapy was then extensively used and researched until the early 1940s, when the discovery of antibiotics, better surgical debridement techniques, and improved anesthesia techniques caused it to fall out of favor. The high cost of maggot debridement therapy in the 1930s also contributed to...
the waning popularity of the technique. In the mid-1980s, research on maggot debridement therapy resumed, and the technique is gaining popularity for individuals with chronic diabetic and pressure wounds that do not respond to other forms of treatment.

Indications

Maggot debridement therapy is used at the High Risk Diabetic Foot Clinic at the Southern Arizona Veterans Affairs Medical Center in Tucson and at the Manchester Royal Infirmary in Manchester, England, for chronic diabetic foot ulcerations that do not heal despite proactive local therapy in patients who are not good candidates for wide-area surgical debridement. The authors occasionally use maggot debridement therapy following intraoperative debridement and have used it extensively to prepare wound beds for use of other, so-called advanced wound-healing modalities, including growth factor therapy, bioengineered tissue, and hyaluronan-based dressings.

Mechanism

Although much remains to be elucidated regarding the details of how maggot debridement therapy works, the basic mechanism of action is readily understandable. The larvae feed on the necrotic tissue and exudate of the chronic wound. A characteristic yellow-tinged exudate is readily observable on inner and outer dressings following maggot debridement therapy, generally corresponding to the degree of preexisting exudate in the wound and the vigor with which the larvae feed. This exudate may also assist in irrigation of bacteria from the wound. Furthermore, maggot saliva and digestive secretions appear to have proteolytic and antibacterial properties. The movement of the maggots may also help stimulate granulation tissue formation.

Application

Through trial and error, the authors have developed a seven-step method for application of maggot debridement therapy that has been successful in their institutions. It is based mainly on published and unpublished descriptions of technique by other practitioners.

Step 1: Manual Sharp Debridement

The first step in successful maggot debridement therapy is the performance of manual sharp debridement of the chronic ulceration to prepare for the placement of the maggots. If eschar is present, it should be excised to the greatest extent possible, as larvae do not penetrate it as efficiently as other necrotic tissues.

Step 2: Application of Skin Preparation

The next step is the application of skin adhesive to the area surrounding the wound. This will facilitate adhesion of the periwound barrier (Fig. 1).

Step 3: Construction of Periwound Barrier

A periwound barrier made of thin hydrocolloid dressing or water-resistant foam tape (Microfoam, 3M, St Paul, Minnesota) is typically applied. The dressing may be cut into strips and applied on all corners of the wound. This barrier helps to reduce the likelihood of larvae migration outside of the intended debridement area (Fig. 2).

Step 4: Preparation of Nylon Chiffon Dressing to Accept Larvae

A nylon chiffon dressing, which is available directly from the Maggot Debridement Project at the University of California at Irvine, is used to accept and contain the larvae on the tissue intended for debridement. This chiffon dressing is generally laid out over a few pieces of moist gauze dressing and placed on a Mayo stand near the wound.

Step 5: Transfer of Larvae to Dressing

Larvae may now be applied to the prepared dressing on the Mayo stand. The number of maggots to use depends on the area of the wound; there should be a

Figure 1. Application of skin preparation after manual sharp debridement.
slight gap between the larvae to allow for growth. The actual number can range from 50 to 1,000 maggots per dressing. This generally amounts to no more than 10 maggots per square centimeter of wound. Maggots should be applied as close to the center of the dressing as possible, as they tend to rapidly migrate to the periphery of the chiffon (Fig. 3). The maggots are supplied in a jar containing approximately 1,000 maggots, which can survive for at least 48 hours before they need to be discarded. The lifespan doubles with appropriate refrigeration.

**Step 6: Application of Maggot Debridement Therapy Dressing to Wound**

The next step is to transfer the prepared nylon chiffon dressing to the wound (Fig. 4). Obviously, this should be done as expeditiously as possible to avoid unwanted migration. Water-resistant foam tape should be used to secure the ends of the dressing (Fig. 5).

**Step 7: Application of Secondary Air-Permeable Dressing**

Finally, the foot should be wrapped in an air-permeable, protective gauze layer, as complete occlusion of the wound would cause a buildup of liquefied necrotic tissue that is not conducive to maggot survival. If the wound is located in an area of pressure, strict nonweightbearing must be maintained to avoid disturbing the maggots. The addition of silver-based dressings (Acticoat, Smith & Nephew, Largo, Florida) to the dressing as a layer just above the most intimate larvae and chiffon layer appears to assist in reducing the bacterial burden on the wound.

**Aftercare**

The patient should return in 2 to 3 days for a dressing change (Fig. 6). The maggots may be removed from the wound with a saline flush and forceps. Upon removal, the larvae will be at least four times their previous size (about 1 cm in length) and many times their pre-debridement mass. The larvae should be disposed of in a standard biohazard receptacle and the ulceration reevaluated. If sufficient debridement has occurred, a standard dressing may be applied. If
further debridement is necessary, the maggots can be reapplied immediately or after 1 week. The authors have achieved optimal results by combining maggot debridement therapy with sharp debridement of these often extremely necrotic wounds. Depending on the size and condition of the ulceration, multiple applications of maggot debridement therapy and sharp debridement may be required before acceptable results are achieved. In recent prospective studies, the average treatment time to achieve a clean, granular wound in recalcitrant wounds ranged from 1 to 2 weeks.\textsuperscript{2, 3, 6} The authors’ experience confirms these findings, but in some cases of large, complex wounds, weekly doses of maggot debridement therapy were administered for more than 2 months.

Dispelling Fear and Apprehension

One might assume that the use of a living organism to debride a wound might provoke anxiety on the part of the patient. However, in the majority of the authors’ patients, this has not been the case. In fact, most people expressing revulsion toward maggot debridement therapy have been other health-care providers. The most frequent question from patients regarding the use of maggot debridement therapy has concerned the life cycle of the larvae. Patients should be informed that the larvae will not undergo metamorphosis inside humans. The green blow fly larva passes through a pupa stage before reaching maturity, which requires burrowing into soil.\textsuperscript{9}

Conclusion

Maggot debridement therapy is an inexpensive and efficient adjunct for treatment of chronic, intractable wounds of the lower extremity. The success of maggot debridement therapy is highly dependent on technique, which involves a small learning curve. Once the technique is mastered, this modality can be a valuable addition to the armamentarium of the physician and surgeon caring for the at-risk limb.

Note: Maggots are available from the Maggot Debridement Project, University of California at Irvine, Department of Pathology (Attn: Ronald A. Sherman, MD), Irvine, CA 92697-4800; e-mail: Rsherman@uci.edu; phone: 949-824-3654; fax: 949-824-1098.

References