

Maggot debridement therapy

Sylvia A. Stegeman & Pascal Steenvoorde*

Leiden University Medical Center, Albinusdreef 2, 2333 ZA Leiden, The Netherlands,
E-mail: s.a.stegeman@lumc.nl, and *Medical Spectrum Twente, Haaksbergerstraat 55,
7513 ER Enschede, The Netherlands

Maggot debridement therapy (MDT) has become more and more common in the treatment of chronic wounds. In the last decade alone, more than 100 papers were published on this subject. MDT is used to aid in removing necrotic tissue from a wound, thus resulting in a reduction of amputations. The limb salvage rate is reported as 50% after use of MDT. This article presents an overview of the history of maggot debridement therapy. In addition, a patient case is discussed.

Keywords: maggot, maggot debridement therapy, surgery, wound care

History of Maggot Debridement Therapy

Maggot debridement therapy (MDT) has been used in wound healing for centuries. In the Old Testament myiasis (human infested with maggots) already has been described. The first European Medical reference appears in the Hortus Sanitanus (1491), probably written by its printer, Jacob Meydenbach (Grassberger 2002). The book consists of a collection of herbal knowledge retrieved from medieval and classical authors such as Galen, Albertus Magnus and Dioscorides.

The first person to observe the beneficial effects of fly larvae on wounds was the surgeon Ambroise Paré (1509-1590) (Goldstein 1931). He described patients who, against all odds, recovered from untreatable gunshot wounds. His opinion was that the 'wurms' he saw, were the result of 'Generatio Spontane' (this theory introduced by Aristotle, states that from an individual of one species a total different species could develop). No evidence, in literature, is found that Paré intentionally used maggots to clean wounds. Baron Dominique Larrey (1766-1842), a famous surgeon in the army of Napoleon Bonaparte, wrote about soldiers who had maggot infested wounds, but was frustrated that it was difficult to persuade his patients to leave the maggots in place. He believed that maggots promoted healing without leaving any damage (Goldstein 1931). The same observation came from a group of imprisoned Confederate medical officers during the American Civil War (Adams 1952). They had to leave the wounds of the soldiers

undressed, because the prisoners were denied any bandages. Many of the Union soldiers, with bandages, died, while the soldiers with larva-infested wounds cleared up quickly. Zacharias, one of the Confederate surgeons, was the first to intentionally apply maggots to the wounds of the soldiers, in order to clean and debride them (Baer 1931). He noted: ‘During my service in the hospital in Danville, Virginia, I first used maggots to remove the decayed tissue in hospital gangrene and with eminent satisfaction. In a single day they would clean a wound much better than any agents we had at our command.... I am sure I saved many lives by their use, escaped septicæmia, and had rapid recoveries.’ (Baer 1931)

In the last century MDT changed from the battlefield to the hospital. The first surgeon to use MDT in a hospital was William S. Baer. In the 1920s he was faced with a group of untreatable patients with severe osteomyelitis (inflammation of the bone), which would nowadays be treated with antibiotics. He successfully treated these patients with maggots (Baer 1931). Because of his success, MDT became a regular therapy in the United States. By 1934 more than 1,000 surgeons were using maggot therapy. Despite the success, dr. Baer experienced some problems with the sterility, with subsequent tetanus developing in some of his patients. This led to the production of sterile maggots by the Lederle Corporation (Puckner 1932). At the same time Alexander Fleming (1881-1951) introduced antibiotics in 1940, which made use of MDT oblivious. This because antibiotics could be produced by the pharmaceutical industry. In the subsequent years maggots disappeared after widespread production and use of the first antibiotic in 1944. However, only 4 years after the introduction of penicillin, more than 50% of the *Staphylococcus aureus* specimens produced β -lactamase, which made these bacteria resistant to the antibiotics (Wainwright 1990, Cazander 2010). This percentage increased over time. The rising antibiotic resistance resulted in failed wound healing and therefore maggots were re-introduced in the 1980s (Sherman & Pechter 1988). In 1989 Dr. Ronald Sherman started rearing larvae and used them successfully in a controlled trial on decubital ulcers (Sherman *et al.* 1995). MDT seemed even to clean the wounds infected with antibiotic-resistant *S. aureus* (MRSA) (Dissemond *et al.* 2002). Maggots became commercially produced. Currently 300 centers in the United States and about 1,000 centers in Europe are using MDT (MDT 2007).

Maggot Debridement Therapy

Maggots are derived from the blow fly, *Lucilia sericata*. The larvae of the fly, the stadium which best can be used for MDT, are relatively small (<2 mm) when they are applied (see Fig. 1) and can grow up to 1 cm in 2 to 3 days (see Fig. 2). To complete the whole blow fly cycle it takes up to fourteen days. The larvae stay only for two to three days on the wound, after that they will be changed for new ones (Steenvoorde 2008).

Success rates for MDT in literature ranges from 70 to 80% (Mumcuoglu *et al.* 1999, Courtenay *et al.* 2000, Wolff & Hansson 2003, Steenvoorde *et al.* 2007). This

percentage depends on a patient selection. A wound of traumatic origin treated with MDT will most likely heal. Wounds combined with open joints, will often have difficulty in healing and mostly it will result in an amputation of the infected joint. Co-morbidities as diabetes, vascular diseases, age, malignancy and ischemia are often predicting the results in a negative way (Steenvoorde 2008).

Debridement

The term 'debridement' comes from the French 'desbrider', meaning 'to unbridle'. In medical terms it means to remove dead, damaged, or infected tissue in order to improve the healing potential of the remaining tissue (<http://en.wikipedia.org/wiki/debridement>). It seems that a chronic wound does not progress through the wound healing phases (haemostasis, inflammation, proliferation and maturation), when the infected or dead tissue is left intact. To ensure wound healing the wound has to maintain a moist wound environment, to keep it free from infection, prevent excessive inflammatory responses and to stimulate the closure of the wound edges (Kirschen *et al.* 2006). Debridement, which results in bleeding, stimulates the production of growth factors. Platelets control bleeding and form a platelet plug. Activated platelets release various growth factors and cytokines (Hunt 1988). These act as chemo attractants for inflammatory cells and mitogens for fibroblasts and epithelial cells, all crucial components for proper wound healing (Zacur 2007). International consensus is that debridement is a vital adjunct in the care of patients with chronic wounds (National Institute for Clinical Excellence 2000, Smith 2002). However, no level 1 evidence has been published if debridement (in any form) has a beneficial effect on wound healing (Bradley *et al.* 1999). MDT is a form of biological debridement. In the next paragraph we will present a patient with a wound after digit amputation of the foot.



Figure 1. Maggots as derived from the producer.



Figure 2. Maggots fullgrown (after 2-3 days).

PATIENT CASE

An elderly patient presented himself to the Rijnland Wound Clinic with a wound after amputation of digit 2 and 3 of his right foot. Previous history revealed that he suffered from diabetes, arterial vascular disease, adipositas and he had smoked for several years. The combination of these co-morbidities caused the capillaries of his right foot to degenerate, which led to gangrene of digit 2 and 3. The treating surgeon decided to amputate the two digits (with removing the metatarsal heads) and leave the wound open for local treatment. No healing tendency occurred during normal dressing therapy. By physical examination we saw an open, yellowish, foul smelling wound between digit 1 and 4. Sharp debridement with a knife was very painful and did not have the required effect. Therefore it was decided to use MDT.

As shown in Fig. 3, the wound edges were taped with plaster. The maggots were placed in a bag - some kind of tea bag - onto the wound (Fig. 4). The dressing is topped with nylon chiffon, as a cage-like dressing (Fig. 5). Wet gauzes and



Figure 3. Amputation wound with debris.



Figure 4. Wound including maggots in a biobag.



Figure 5. Concealed wound.



Figure 6. Removal of the bandage.

a light bandage were put over for moistening. For wetting normal saline (0.9%) was used. After 3-4 days the patient was ordered back to the Wound Clinic to remove the bandage with the maggots (Fig. 6). The whole treatment required several dressing changes. After the last treatment the wound was red, meaning that the necrotic, yellow tissue was resolved by the maggots (Fig. 7). Figs 8 and 9 show the wound in a later stadium: almost closed. The whole healing process took 2-3 months.

DISCUSSION AND CONCLUSION

Since centuries MDT is used, intentionally or not, on wounds. The last century MDT is used actively in chronic wounds. After the invention of penicillin, MDT was applied in a lower scale, until the 1980s when MRSA became a problem. In this period MDT developed in to what it is now. For complicated wounds, with a high chance to be amputated, the use of maggots could be limb saving (Jukema *et al.* 2002). In the case described above, MDT had a positive effect on the wound healing. If a wound is too painful for a sharp debridement, it sometimes has to take place in theatre under general anaesthetics. The use of maggots can reduce the necessity to go to the theatre for a surgical debridement. However, every individual case has to be evaluated separately.

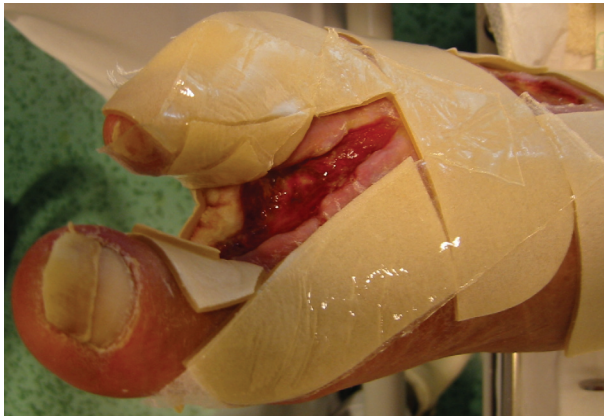


Figure 7. Red wound surface is shown.



Figure 8. Scar tissue removed: a small red wound.



Figure 9. Wound almost closed.

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