Maggot Debridement Therapy (MDT)

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Fly larvae have been used as an intentional biotherapy to debride infected wounds for the last thousand years, as written records show.[1] This ancient biotherapy has gone through a period of resurgence over the past several years. In current day medical use, maggot debridement therapy (MDT) is referred to as "biosurgery." The purpose of this article is to describe maggot therapy, review the literature documenting the validity of this therapy, and to review the use of MDT as a method of infection control.

Documented indications for MDT include:[2-8]

- Diabetic foot ulcers (DFU)
- Venous and arterial leg ulcers
- Gangrene and osteomyelitis
- Necrotizing fasciitis
- Traumatic necrotic leg wounds
- Intractable sacral wounds
- Burns

DEBRIDEMENT AND WOUND HEALING

Debridement represents the hallmark of wound bed preparation. This procedure facilitates wound inspection, removes bacteria and devitalized tissue, and stimulates the production of essential growth factors.

Steed (1996) observed that debridement created bleeding which could activate platelets to release the contents from their growth factor-rich alpha-granules, thus stimulating an inflammatory response.[9] Williams, et al. (2005) noted the attraction of neutrophils and macrophages increased subsequent to debridement. The actions of these cells included secretion of growth factors and phagocytosis of bacteria. Researchers observed that cytokines and growth factors functioned more effectively in an exudate and slough-free environment.[10]

Debridement may be accomplished in several ways:

- Surgical
- Enzymatic
- Autolytic
- Mechanical
- Biologic (such as MDT). Fly larva, *Lucilia sericata*, are used as a form of biological debridement for cleaning non-healing wounds

THE ROLE OF MAGGOTS IN WOUND MANAGEMENT

Maggots cause liquefaction and removal of necrotic tissue. Larvae kill bacteria by ingestion, digestion, and antibacterial secretions. Maggots stimulate healthy granulation tissue. Changes created by this therapy in the wound environment may further encourage growth, resulting from secretion of calcium carbonate, allantoin, and urea. Disinfection is presumed to occur as a result of digestion, possibly combined with secretion of antimicrobial molecules.[11]

Maggots may enhance tissue formation within wounds via promotion of fibroblastic motility, providing for a wider distribution of viable fibroblasts. This therapy may be useful in patients where other aggressive treatments have failed or when sharp debridement is contraindicated; these include individuals who are not surgical candidates, and those with wounds exhibiting pathergy such as *pyoderma gangrenosum*, among others.[12]

Anecdotally, biosurgery is generally well-tolerated with few side effects. In rare cases, patients have a mild febrile reaction.[13] Patients usually welcome any therapy that may heal their wounds and are often receptive to biosurgery when appropriately educated and counseled. Conversely, some clinicians, nurses, and administrators often have a different point of view ("yuk factor") and are squeamish about the process.[14]

Steenvoorde, et al. (2005) observed that patients utilizing maggot therapy usually tolerated the procedure without incident or side effects.[15] A retrospective study of 41 patients treated with MDT concluded that in 78% of patients pain could be adequately treated outpatient with analgesic therapy.[16] If pain symptoms were unmanageable, other options included hospitalization or cessation of therapy.

BIOSURGERY IS COST-EFFECTIVE

In a small randomized control trial, MDT appeared more economical than hydrogel. All wounds treated with larval therapy were successfully debrided following one application at a medical cost of £78.64 (approximately US $115), while in the hydrogel group, one-third of wounds still required treatment after one month, costing an average of £136.23 (~US $200).[17] The sample size of this study was low, only 12 patients; however, this issue was discussed by the research group in their limitations, citing the need for a larger study.

In the United States, select biotherapy laboratories reproduce and distribute disinfected medical maggots. The average cost per unit (100 maggots) is between US $18-22. Medical Maggots™ are FDA cleared, and therapy is reimbursed by public and private insurances.[18]

NEXT GENERATION MAGGOT THERAPY

The role of Platelet Derived Growth Factors (PDGF) in wound healing has been well established in the literature. PDGFs stimulate fibroblast proliferation and chemotaxis, actin reorganization, and production and secretion of other growth factors, metalloproteases, and ECM constituents.[20]

Linger, et al. (2016) are attempting to bioengineer a breed of fly larvae which secrete/excrete human growth factors. By performing transgene insertion, this research group is changing the genetic makeup of the larvae. This research shows inducible production of human PDGF-b RNA and PDGF-BB protein. After altering the organism's code, researchers detected PDGF-BB protein within maggot hemolymph. In theory, the concept of the natural debriding characteristics of the maggot coupled with the potential of excreting human growth factors into a wound bed could be world changing. These researchers from North Carolina State University refer to the use of these modified larvae for debridement, "Enhanced MDT."[21]

CONCLUSION

MDT represents a viable alternative for many wound types, particularly in those patients who are not candidates for sharp debridement or those who may develop pathergy. MDT works by debriding wounds while dissolving necrotic tissue, disinfecting wounds by killing bacteria, and stimulating wound healing with minimal pain.

Additionally, MDT may be useful in eradicating many bacteria, including MRSA, safely and cost-efficiently. Research remains ongoing and large randomized studies are required to justify MDT as a mainstay in modern wound management.

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