Research Paper

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Maggot Debridement: an Alternative Method for Debridement for Chronic Ulcers

MEDICAL SCIENCE

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Dr. Bharat Kumar Suthar	PG Scholar , National Institute Of Ayurveda 17,Ganesh colony, Jorawar singh gate, Amer road, Jaipur-302002(Raj.)
Kumar Gautam	Lecturer SBLD ayurved vishwabharati, Sardarshahar, Distt. Churu(Rajasthan)
Dr.Ashish Pareek	PG Scholar , National Institute Of Ayurveda 131-132, Shri ram nagar, Kalwar Road, Jhotwara, Jaipur

ABSTRACT

A chronic wound that does not heal in an orderly set of stages and in a predictable amount of time the way most wounds do. These wounds cause patients severe emotional and physical stress and create a significant financial burden on patients and the whole healthcare system.

The mechanism of such maggot therapy was shown to be due to the debridement, disinfection, and wound healing enhancement actions of maggot secretions. The efficacy of MDT in chronic wound management has been demonstrated in chronic venous ulcers, pressure ulcers, and diabetic ulcers. MDT has been described in Sushruta samhita in context of ulcerated growths (arbuda chikitsa) for the wound debridement in chikitsa sthana 18. Their use declined with the advent of antibiotics. MDT is more selective than surgical debridement, decreases time to healing and stay of patients in the ward, and may decrease the risk of major amputations. However, the evidence of these effects of MDT on the highest level is presently lacking.

INTRODUCTION

Impaired wound healing is a common and costly problem for the patients. We evaluated the efficacy of an unconventional but simple treatment, long acclaimed as an effective maggot therapy. For years maggot therapy has been recognized as an aid in debridement and wound healing. Medicinal maggots secrete digestive enzymes that selectively dissolve necrotic tissue, disinfect the wound and stimulate wound healing. During the 1930s, maggot debridement therapy (MDT) was routinely used in hundreds of hospitals around the world for treating bone and soft-tissue infections. With the introduction of antibiotics and other improvements in wound care, by the 1960s maggot therapy was used only as salvage therapy for the most serious wounds.

Sterile maggots of the green bottle fly, are used for MDT. Previously, necrotic tissue like eschar or scab often like pus was looked upon as a natural part of the healing process. More recently, however, it has been known that tissue necrosis influences the healing process in a negative way resulting in a delayed or even stopped healing process.

Wound debridement is defined as the removal of foreign material and dead contaminated tissue from a infected lesion to expose healthy tissue. It may also include removal of foreign material that has become embedded in the wound. The main reason for debriding a wound is to avoid substratum for bacterial growth, inflammation and leukocyte infiltration with delayed progression to the proliferative and remodelling phases of wound healing, compromised restoration of the structure and function of the skin, odor management issues, and other negative effects.

The Aboriginals in Australia and Maya tribes in Central America used larvae frequently to clean wounds. William Baer was the first surgeon that employed larvae of the Lucilia sericata type for the treatment of children with osteomyelitis in 1929. Baer described a fast debridement, the reduction of bacterial amounts, a decreased odour and alkalinisation of the wound surface.

The aim of this this article is to describe the mode of action, when to use MDT, the practical use of MDT in debridement, clinical results, and discuss the problem of creating evidence for the clinical effect of MDT.

HISTORY

The extensive use of maggot therapy prior to World War II was curtailed when the discovery and growing use of penicillin caused it to be deemed outdated. Due to the lack of conventional medicines, maggot therapy was used by Allied military medical staff in Japanese prisoner of war camps in the Far East throughout World War II.

With the advent of antibiotic-resistant bacteria, Dr. Ronald Sherman, a physician previously at the University of California, Irvine, sought to re-introduce maggot therapy into the armamentarium of modern medical care. In 1989, he set up fly breeding facilities at the Veterans Affairs Medical Center in Long Beach, California in order to use maggots for the treatment of wounds. Using a Paralyzed Veterans of America grant, he initiated a prospective controlled clinical trial of maggot therapy for spinal cord patients with pressure ulcers who had failed two or more courses of conventional wound care.

In a 2007 preliminary trial, maggots were used successfully to treat patients whose wounds were infected with MRSA, a bacterium (Staphylococcus aureus) with resistance to most antibiotics, including methicillin. Some of these strains include flesh eating bacteria causing frequent deaths upon infection of deep tissue. Maggots clean up the already dead tissue thus preventing further infection spread.

APPLICATION OF MAGGOT WOUND DRESSINGS

Larvae used for MDT need to be sterile to prevent contamination, and therefore must be bred in a controlled sterile, moist environment. Newborn larvae should be used within 8 hours or stored in a refrigerator at 8º to 10ºC, so as to slow their metabolism. To maximise debridement, it is important to ensure an optimal body temperature, adequate oxygen supply and moisture.

Maggots are contained in a cage-like dressing over the wound for two days. The maggots may be allowed to move freely within that cage, with the wound floor acting as the bottom of the cage; or the maggots may be contained within a sealed pouch, placed on top of the wound. The dressing must be kept air permeable because maggots need oxygen to live. Propylene glycol from hydrogel dressings can limit the growth and viability of larvae, while systemic antibiotics do not affect larval development.

Net boot dressing -A method in which a net boot is used to cover extremities. The boot is widely used for its convenience and because of the low risk of maggots escaping. Commercial stockings involve some risk of escape, so these specially made net boots are normally used.
Cage dressing dressing - A method in which a cage-like dressing is constructed and used to treat wounds on the body trunk for which a net boot cannot be used. It has the disadvantage of being time-consuming to apply and involves some risk of maggots escaping.
Biobag dressing - A method using a pouch-like mesh bag that contains maggots. The biobag is convenient, involves almost no risk of maggots escaping, and can reduce the pain that may arise as one of the side effects. It also has the advantage of allowing clinicians to observe and rinse out wounds if necessary. On the other hand, it cannot properly debride heavily uneven wounds or wounds with pockets or dead spaces.

MECHANISMS OF ACTION

The maggots debride wounds by dissolving necrotic and infected tissue. As well as vital tissue when dose is too high or time of treatment is not appropriate. Disinfection of the wound by killing bacteria and healing could not be proved by the largest clinical study available. Maggot therapy may also reduce the need for antibiotics in people with complex, chronic wounds.

Debridement

The debridement of necrotic tissue using maggots or other methods has not been proven to provide medical benefit compared to no debridement. In maggot therapy, large numbers of small maggots consume necrotic tissue more precisely than is possible in a normal surgical operation, and can debride a wound in a day or two. They derive nutrients through a process known as "extracorporeal digestion" by secreting a broad spectrum of proteolytic enzymes that liquefy necrotic tissue and absorb the semi-liquid result within a few days. Within a period of 3–4 days by ingesting necrotic tissue, leaving a clean wound free of necrotic tissue when they are removed. Maggots use a pair of hooks for movement and attachment, and it was believed that the probing from the hooks may facilitate debridement. Recently, three proteolytic enzyme classes have been identified in the maggot secretions. These enzymes effectively degrade extracellular matrix components, including laminin and fibronectin. That assist in the digestion of the wound matrix, leading to effective debridement.

Disinfection

If the wound is infected with an antibiotic-resistant bacterial strain, it becomes difficult or impossible to treat the underlying infection and for any healing to occur. When maggots successfully debride a necrotic wound, the source of wound infection is usually removed. Maggot secretions are also effective against some antibiotic-resistant bacteria and have been shown to possess potent antimicrobial activity in early experimental studies. Secretions believed to have broad-spectrum antimicrobial activity include allantoin, urea, phenylacetic acid, phenylacetaldehyde, calcium carbonate, proteolytic enzymes, and many others. Bacteria not killed by these secretions are subsequently ingested and lysed within the maggots.

Wound healing

Certain agents in maggot secretions also promote regrowth of healthy granulation tissue by accelerating angiogenic activity and/or fibroblast migration. It was believed that the enhancement in tissue growth was due to an increase in fibroblast proliferation brought. It altered fibroblast adhesions to collagen and fibronectin, and it was subsequently shown that it increased the migration of fibroblasts. Their results were consistent with the previous studies and supported by later investigators. An upregulation of tyrosine phosphorylation was also detected, which possibly enhanced the motility of the fibroblasts. It have been postulated that maggots secreted cytokines, which help wound healing. High levels of gamma-interferon and interleukin-10 (IL-10) were found in this, but as to whether these cytokines are responsible for increasing granulation requires further investigation.

Limitations

The wound must be of a type which can actually benefit from the application of maggot therapy. A moist, exudating wound with sufficient oxygen supply is a prerequisite. Not all wound-types are suitable. Wounds which are dry, or open wounds of body cavities do not provide a good environment for maggots to feed. Maggots have a short life which prevents long term storage before use. Patients and doctors may find maggots distasteful. Maggots can be enclosed in opaque polymer bags to hide them from sight. Dressings must be designed to prevent any maggots from escaping, while allowing air to get to the maggots. Dressings are also designed to minimize the uncomfortable tickling sensation that the maggots often cause.

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