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A brief review on Maggot Debridement Therapy- an Ayurvedic approach

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ABSTRACT:

Many Chronic non-healing wounds require alternative approaches, in addition to standard conventional therapies. Debridement by using maggots is in practice since centuries. Here is an attempt to precisely collect the information regarding maggots, cultivation of maggots using *Sushruthoktha chikitsa* for *Kaphaja arbuda* , its usage and the disposure of maggots been delt elaborately.

INTRODUCTION:

Maggot debridement therapy (MDT) or the use of maggots to treat wounds is one such therapy that has been in use for centuries[1]. MDT is a form of therapeutic wound treatment in which sterile or disinfected larvae of certain blowfly species are used to remove non-vitalized tissue, pus, slough, promote healing. The methods of debriding a wound can be classified as surgical, autolytic, mechanical, enzymatic, or biological[2]. Sterile MDT is approved by FDA as a "Medical Device" in 2004 U.S.A. and European country. According to FDA maggots are approved for treating neuropathic (diabetic) foot ulcers, pressure ulcers, venous ulcers traumatic and post-surgical wounds unresponsive to conventional therapies (1931) The success rate of MDT was reported in literature ranges from 70% to 80%. The use of maggots for medical purposes is not new. The oldest documents referring to interventions using larvae date from antiquity, and the first scholarly publications date from the 1500s, when the French surgeon Paré described the stages of healing of a large wound in the skull in the presence of maggots [3].

KEYWORDS : Maggots, chronic wounds, *Lucilia sericata*, biological debridement.

MAGGOT BIOLOGY:

Maggots are fly larvae or immature flies, just as caterpillars are immature butterflies or moth larvae.[4] On hatching, 1st stage larvae are roughly 2 mm long and grow to about 5mm before shedding their skin.

History of Maggot Therapy.

Early use in 2000BC-1860s

Modern use -1920-1940s

Reintroduction-1990s

FDA Regulation-2004

DEFINITION:

MDT is a type of biotherapy involving the introduction of live, disinfected maggots (fly larvae) into the non-healing wound of a human or animal for the purpose of Cleansing Out The Necrotic Tissue, and Promote Wound Healing.

Biological débridement has been used since antiquity by applying larvae of *Lucilia sericata* (greenbottle fly) into wounds. The Larvae digest only the necrotic tissue and pathogenic bacteria, leaving the healthy tissue unharmed. More recently, sterile medical grade larvae have been made avialable. The larvae provide rapid and relatively selective débridement. Unfortunately, there is often a problem with client compliance as there is a reluctance to allow the larvae to inhabit the wound. There is some evidence that secretions of the larvae may be able to be used for débridement, antibacterial effects, and promotion of angiogenesis.

WHAT ARE MAGGOTS?

A maggot is the larva of a fly. Lucilia (Phaenicia) sericata are the most widely used species for MDT due to its preference for feeding on necrotic tissues.

LIFE CYCLE OF MAGGOTS:

►Life cycle begins when adult female flies deposit clusters of eggs (about 1000 $2000) on wounds of humans or animals, where they hatch in 18-24 hrs..

►Eggs are usually white, elongated with one end tapered slightly.

Development of larvae includes three stage, i.e., 1st-2mm, 2nd-3-4mm and 3rd 7 8mm instars. The size of mature larvae are 10 mm, respectively.

>After maturation of 3rd instar larvae, they pupate after 7-10 days.

►After a pupal period in 10-14 days the adult fly emerges.

WHAT IS DEBRIDEMENT?

The process of removing Dead, Contaminated, or Infectious Adherent

Tissue or Foreign Materials from a wound.

Five primary methods:

1. Mechanical Debridement
2. Enzymatic Debridement
3. Sharp Debridement
4. Autolytic Debridement
5. Biologic Debridement

MAGGOT DEBRIDEMENT THERAPY:

Controlled "Application of disinfected maggots to the wound to remove the necrotic tissue.

Maggots are left in the wound for 2-4 days.

They secrete "Proteolytic enzymes" that break down necrotic tissue and then ingest the liquefied tissue"

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MDT is based on three mechanisms, observed when *Lucilia sericata* are introduced to the wound: the mechanical removal of necrotic tissue, bactericidal and bacteriostatic activity, and promotion of the healing process. Reports from the last decade point out that physical contact with the wound is a less important effect of the larval presence within the wound, and is probably a negative effect for the patient, who may feel a physical presence and wiggling in the wound. Chemicals secreted by larvae initiate the process of bacterial elimination and remodeling of the wound bed [4,5,6].

STERILE MAGGOTS:

Eggs are collected from gravid females of L. Sericata laboratory colony).

These eggs are disinfected with a 3% Lysol Brand Disinfectant or 0.5% sodium hypochlorite.

Transferred to sterile vials and left at room temperature over right.

About 500-1000 larvae in each via are available for clinical use.

THERAPEUTIC TYPE OF MAGGOTS:

Maggots are microbiologically tested before use. One day old maggots are shipped in a temperature controlled package.

They should be used as soon as possible, but essential maturation can be detained by storing at refrigerator temperature (4-8°C) for 2-5 days.

Maggots are supplied either in free range or in biobag by constructed laboratories owned by companies such as Bio Monde Zoo Biotic.

AYURVEDIC METHODS OF MAGGOT CULTIVATION:

Nispava, Pinyaka and paste of kulattha added with Mamsa and Dadhi mastu should be applied on the "Kaphaja Arbuda.

This facilitates the growth of the krimi due to swarming of the files.

" निष्पावपिण्याककुलत्थकल्कैर्मांसप्रगादैर्दधिमस्तुयुक्तैः ।

लेपं विदध्यात् कृमयो यथाऽत्र ॥

मूर्च्छन्ति मुञ्चन्त्यथ मक्षिकाश्च |

अल्पावशिष्टे कृमिभक्षिते [] च ।

लिखेत्ततोऽग्निं विदधीत पश्चात्

यदल्पमूलं त्रपुतामसीसपद्वैः समावेष्ट्य तदायसैर्वा ॥

(Su.Chi. 18/37)

AYURVEDIC ASPECT OF MAGGOTS:

Acharya Sushruta explains maggot therapy in the treatment of Kaphaja Arbuda". In Arbuda the main Dooshya is Mamsa. The Gunas of kapha and that of Mamsa both favors conducive atmosphere for the Krimis.

The application of Nispava dravyas are done mainly to attract the flies and create anenvironment favorable for the growth of the krimis.

Apart from this it also helps in selection of the right kind of flies, because not all fly larvae have affinity to the diseased tissues, this is achieved by the application of Mamsa, to the affected area due to which only such files that crave for the dead tissues are attracted.

INDICATIONS (ACCORDING TO FDA):

Non-healing pressure ulcers, venous ulcers, neuropathic foot ulcers. Non-healing traumatic or post-surgical wounds. Antibiotics are ineffective and surgery impracticable.

Infected traumatic wounds especially in diabetic foot.

In destroying malignant tissues.

PRE OPERATIVE PROCEDURE:

Maggots (1-2 mm) are collected by licensed laboratories in sterile bottles.

The wound is cleaned with normal saline solution.

Maggots are applied to the wound at a dose of 5-10 maggots/cm² of wound surface area.

The number of maggots applied to the wound depends on the area of necrotic tissue, wound depth and width of wound.

METHOD OF APPLICATION:

Maggots are applied on the wound in two-ways,

1.FREE RANGE

2. BIOBAG.

FREE RANGE (Direct contact method):

In free range dressing, maggots are applied directly to the wound for 3-4 days and allowed to roam freely over the surface areas of slough or necrotic tissue.

BIOBAG (Indirect contact method):

In biobag dressing, the maggots are enclosed in Net Pouches containing pieces of Hydrophilic Polyurethane Foam.

These bags are placed directly upon the wound surface for 5 days, so that maggots cannot escape dressing and the structure of the mesh enables the proteolytic secretions to reach the necrotic tissue and maggots can still aid in debridement.

After Application:

24 hours after the application of maggots, Wounds which have an acidic in nature turns into alkaline, after feeding on necrotic tissue in wounds, they can grow up to 1 cm in 2-3 days.

During the first 2 days, there is slight amount of odour due to the phagocytic activity of maggots, later on this odour ceases, wound become alkaline.

Alkaline reaction is helpful in the sterilization of the wound and killing of the bacteria.

Maggots are left within their dressing (cage dressing) for 3-4 days after that, maggots are satiated and can no longer remove any necrotic tissue.

Post application care

On 5th day maggots should be removed, the wound should be thoroughly washed out with saline solution, and a new batch of maggots should be applied to the wound until the wound is completely debrided.

At the end of the second application, the wound is completely filled with granulation tissue

Maggots are germ-free when applied, but become contaminated when they come in contact with the patient's wound flora. Therefore, MDT dressings should be handled like all other infectious dressing waste.

Place the maggot dressings in a plastic bag and seal the bag completely. Then place the sealed bag into a second plastic bag and seal completely.

Place the bag with the other infectious dressing waste in an appropriate infectious waste bag and autoclave or incinerate within 24 hours, according to waste management policies.

Mode of action

Maggots work by three mechanisms they debride wounds by dissolving necrotic tissue, cleaning wounds by killing**,** promote wound healing. Larvae have a broad antibacterial action against Gram-negative and Gram-positive bacteria. MDT helps to separate necrotic tissue from the underlying bed, kills microorganisms, disrupts biofilm, Hastens Wound Healing Through A Broad Range Of Factors Including Leukocyte Adhesion-Growth Factor Production, Collagen

Production, Increased Angiogenesis, Increased Macrophage Responsiveness, Increased Fibrinolysis, Increased Nitric Oxide levels (help in apoptosis & angiogenesis)

Mechanism of Action

Maggots move over the surface of the wound secreting a powerful mixture of digestive enzymes such as Carboxypeptidases A And B. Leucine Aminopeptidase, Collagenase, Serine Proteases Metalloproteinase and Aspartyl Proteinase Bactericidal and bacteriostatic properties Secretions of maggots increase the wound pH through secretion of Sodium Bicarbonate, thereby inhibiting the growth of bacteria. Secretions contain bactericidal components with healing properties such as Allantoin, Urea, Phenylacetic Acid, Phenylacetaldehyde, And Calcium Carbonate, especially against staphylococcus epidermidis, S. aureus and pseudomonas aeruginosa. Maggots also decrease surface bacterial load by ingesting Escherichia coli.

Normal wound healing is a dynamic and complex process involving a series of coordinated events, including bleeding, coagulation, initiation of an acute inflammatory response to the initial injury, regeneration, migration and proliferation of connective tissue and parenchyma cells, as well as synthesis of extracellular matrix (ECM) proteins, remodelling of new parenchyma and connective tissue and collagen deposition regulated by cytokines and growth factors [9]. Four well defined phases can be recognised during a healing process - haemostasis (coagulation), inflammation, repair (cell migration, proliferation, matrix repair, and epithelization), remodelling and maturation of the scar tissue [10].

Debridement methods include surgical, sharp, autolytic, osmotic, and larval. Larval debridement is also known as maggot debridement therapy (MDT) or biosurgery and is used in the treatment of chronic wounds of diverse etiologies.[2–4] This therapy uses living blowfly larvae, principally a specimen of green bottle blowfly (*Lucilia sericata*) that are raised in controlled sterile laboratory conditions. This method of debridement is considered selective because blowfly maggots destroy dead tissue, but not healthy tissue, and it is based on three therapeutic actions: debridement, disinfection, and promoting skin growth.[6–11] The process of MDT begins when tiny spicules on the maggots' bodies scrape necrotic tissue. Next, the larvae secrete chemicals rich in proteolytic digestive enzymes that dissolve the necrotic tissue; the resulting product of this extracorporeal digestion is then ingested by the larvae. Several substances inside these secretions may partially explain MDT's antimicrobial and growth promotion actions.[7,8,12–15]

Maggots can be applied directly to an ulcer, with a dressing to cover them and prevent them from escaping. The dressing must allow air flow and moisture to reach the maggots. This technique does come with some special considerations; for example, maggots should not be applied close to big blood vessels or in patients at high risk of bleeding, and the skin edge must be protected from excoriation.[6,8,14–16]

APPLICATION PERIOD: 24 to 48hours

The number of treatment cycles depends on the size of the wound, the average course is 2-4cycles. Depending on Necrotic Tissue, Slough Formation and Wound Response sitting can be vary to each individual cases. The ultimate goal of MDT is Wound Debridement Preparation for Graft, Or Wound Closure).

COMPLICATION

Adverse reactions to MDT Usually does not happen and only side effects observed are irritation, itching, hypersensitivity at the wound site. Sometimes it also causes pain, discomfort at the first change of dressing

LIMITATIONS

A moist wound with sufficient oxygen supply is a prerequisite.

- Not all wound-types are suitable: wounds which are dry open wounds of body cavities do not provide a good environment for maggots to feed.
- In some cases it may be possible to make a dry wound suitable for larval therapy by moistering twith soaks applied for 48 hours.

CONTRA INDICATION

‣ Maggot therapy should not be used in open wounds of body cavities or sinuses, fistulae.Wounds in close proximity to large blood vessels. Wounds close to the brain with neoplasia. Wounds with large necrotic areas such as a large area of osteomyelitis. Patients with rapidly advancing infection and sepsis should not initially be treated with MDT.

OUT COME AND SCOPE OF MAGGOT THERAPY

Success rates for MDT in literature ranges from 70 to 80%. This MAGGOT DEBRIDEMENT THERAPY percentage depends on patient selection.A wound of traumatic origin treated with MDI 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 Infecred cint Co-morbidities as diabetes, vascular diseases age, malignancy and Ischemia are often predicting the results in a negative way. Further clinical studies are needed in several fields, including establishing a number of maggots required for safe and efficient treatment identification of adverse effect during treatment. MDT will add one more treatment method to utilize in non-healing wounds of humans some cases it overcome amputation. Attempts are currently ongoing to extract or synthesize the found in larval secretions to destroy MRSA (Methicillin Resistant Staphylococcus Aureus) without application of the larvae.

ADVANTAGES

Easiness in application, safe without any serious side effects. Efficiency in wound debridement makes maggots therapy the first line therapeutic tool in both hospital and outpatient surgery. Decreases the usage of antibiotics.

DISADVANTAGES

- Difficulty for patient to give consent.
- Not useful for Dry wounds.
- Maggots are highly perishable and should be used within 24 hours of arrival so no long term storage. transportation problems as there is viability problems.
- It is not so effective wound of >3 month old wound with exposed tendon, muscle, bone.
- Not indicated in open wounds of the abdominal cavity. It is not used in patients with immune suppressive therapy.

DISCUSSION:

As Acharya Sushrutha explained the treatment of *Kaphaja Arbuda* which mimics the symptoms of chronic ulcers for example *Kaphaja dushta vrana* which can be co-related to Diabetic Foot ulcer. Thus the method of maggot cultivation and its application on DFU promotes the biological debridement, thereby reducing exudates with anti-microbial activity by releasing the enzymes. By this it can be assessed, the method of biological debridement gives maximum benefits in saving the affected area in proper way of its utilization.

CONCLUSION:

Acharya Sushrutha has explained the chikitsa long standing ulcers while dealing with *Kaphaja Arbuda chikitsa*

Larval therapy is a safe and effective way to remove dead tissue during wound care. It is connected with debridement, disinfection, and increased tissue growth. MDT may shorten the duration of antibiotic medication and reduce the need for hospitalisation, as well as the number of outpatient visits required. This is a reasonably inexpensive strategy that, in addition to financial benefits, may result in other good outcomes, such as fewer beds occupied on a hospital ward. Recent research data demonstrate a decrease in biofilm and bacterial load in the wound, as well as a good effect on wound remodelling. Medicinal maggots are as exact in their debridement as a professional microsurgeon, and as concerned about their hosts' wounds as the most diligent wound-care nurse. It is no surprise that they have made their way into the hearts and wounds of so many people.

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