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A Treatment Option in Diabetic Foot: Maggot

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I. Introduction

Diabetes is a serious health problem that of prevalence and incidence are gradually increasing and that affects quality of life. Diabetes leads to microvascular complications such as nephropathy, retinopathy, and neuropathy as well as macrovascular complications such as coronary artery diseases, peripheral artery disease, and stroke (http://clinical.diabetesjournals.org/content/26/2/77.full).Diabetic foot ulcer resulted by the combination of neuropathy, micro- and macroangiopathy, caused by diabetes, is one of the common complications. 49% of diabetic patients were found to have a high risk of diabetic foot ulcer (Wu et al. 2015). Diabetic foot ulcer is an important complication that can result in loss of movement, physical-emotional stress, amputation and mortality and that affects the quality of life (http://www.diabetcemiyeti.org/var/cdn/8/a/baris-akinci.pdf).Management and treatment of the disease are very difficult when diabetic foot ulcer progresses.

In treatment of diabetic foot ulcers, it is important to keep blood glucose below 200 mg/dl, to administer local wound care, wound debridement, revascularization procedures and reduce the burden on the ulcer. In the treatment of ulcers there are many options suchs as antibiotics, hyperbaric oxygen therapy, continuous or intermittent negative pressurized and vacuum assisted aspiration, granulation, reinforcement of growth factors and cytokines causing angiogenesis, use of modern wound care materials appropriate to the patient and needs of the wound, hemoglobin spray, ozone therapy, extracorporeal shock waves (Wainstein 2011, Waniczek et al. 2013, Kranke et al. 2015, Liu et al. 2015, Bateman et al. 2015, Wang et al. 2015).

Maggot debridement therapy is another option for diabetic foot ulcer (Sherman 2014, Wilasrusmee et al. 2014). The maggot debridement therapy known as biological debridement is use of sterilized larvae of Lucilia (Phaenicia) sericata fly which is called green bottle glass, a fly species belonging to the Insecta class, Diptera order, Cyclorrhapha sub-order, Calliphoridae family, Lucilia genus (Mumcuoğlu and Özkan 2009, Tanyüksel et al. 2014). Larvae treatment, therapeutic myiasis, bio-surgical debridement expressions are also used instead of maggot treatment in literature (Tanyüksel et al. 2014).

The beneficial effects of larvae on the wound were first discovered by Ambroise Pare in 16th century, then first described in 1931 by Baer. In the following years, maggot debridement therapy has become less important with the discovery of antibiotics and the use of surgical debridement and maggot therapy has begun to be used as an alternative to antibiotics (Mumcuoğlu and Özkan 2009, Pettican and Baptista). This therapy method was approved by the United States Food and Drug Administration (FDA) in 2004 (Collier 2010). After FDA approval, maggot therapy has begun to be used in chronic wounds and diabetic ulcers in many countries. In our country, it was first used in Gülhane Military Medical Academy in 2002, then, maggot production was started at the Department of Medical Microbiology, Cerrahpaşa Medical Faculty of Istanbul University in 2008 and sterile maggot was provided from here to doctors who wanted to use maggot therapy (Tekin et al 2007).

Maggot debridement therapy is applied in two ways, in the form of cage dressing using hydrocolloid material and as biobag method. When maggot is applied in cage style using hydrocolloid material, the hydrocolloid material is cut to the size of wound and the middle part is left to leave the wound open. A dacron gauze or sterile transparent nylon is used, as slightly larger than the open wound surface, slightly smaller than the hydrocolloid material. At this stage, one edge of dacron gauze or sterile transparent nylon is removed and maggots are placed in this area and covered. In the second application method, biobag method, maggots are inserted between two pieces of gauze made of a special material (polyvinylalcohol-hydro-sponge) with a thickness of 0.5 mm and put on the wound after closing the bag by sticking. The biobags placed on the wound are wrapped with a bandage. 2-4 maggot cycles are needed for 3-4 days for complete debridement (Mumcuoğlu and Özkan 2009, Ricci & Chadwick 2014, Dholaria et al. 2014).It has been reported that the biobag method is better tolerated by the patients, that it causes less pain than the other methods, that there is no possibility of escape of maggots from the wound bed and that it is an easy method to apply. Moreover, it has been stated that

the maggot application debrides more tissue in cage style dressing (Mumcuoğlu and Özkan 2009, Ricci & Chadwick 2014).

The effect of maggots' on the healing of diabetic foot ulcers is caused by debriding the wound and contributing to the formation of granulation by providing disinfection. In the study carried out by Tellez et al. (2012), it was determined that this therapy is effective in debridement of minimal tissue necrosis (Tellez et al. 2012). Other studies also reported that maggots accelerate wound healing by increasing blood flow to the ulcer zone (Marineau et al. 2011, Maeda et al. 2014). Another reason why maggots are effective in healing wounds is that the substances they secrete have anti-bacterial and anti-fungal properties (Arora et al 2011, Blueman and Bousfield 2012, Evans et al. 2015). In the study carried out by Arora et al. (2011), it was reported that the original secretions of maggots inhibit the growth of partial bacteria, have an anti-staphylococcal effect and reduce the bacteria by 50% after 24 hours of treatment (Arora et al. 2011). Blueman and Bousfield (2012) have shown that maggot therapy is effective against gram-negative and gram-positive bacteria such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus aureus* (Blueman and Bousfield 2012).

It has been reported that maggot debridement therapy is a safe, cheap and effective alternative in chronic wound healing and that it gives positive results in a short period of time compared to the conventional therapy (Chan et al. 2007, Wilasrusmee et al. 2014). In the study carried out by Wilasrusmee et al. (2014), maggot therapy was applied to a group of patients with diabetic foot ulcers and conventional therapy was applied to another group. The rate of wound healing was found to be approximately 8-fold and 20% greater in patients received maggot therapy than those who received conventional therapy (Wilasrusmee et al. 2014). In a different study, maggot debridement therapy was reported to have a more positive effect on wound healing in patients with diabetic foot ulcers compared to conventional therapy, to significantly shorten the healing period in ulcers and to increase the rate of healing of chronic wounds (Sun et al. 2014).Opletalova et al. (2012) conducted a study with 119 patients who had a crusted wound $\leq$40 cm2, with a depth of less than 2 cm, and they applied maggot therapy to a group of patients and conventional therapy to another group of patients.The patients were followed for 30 days and it was determined that there was a statistically significant difference between the group receiving maggot debridement therapy (amount of crust 54.5%) and the control group (amount of crust 66.5%) in 8 days and that the mean percentage of the crust was 55.4% in the group receiving maggot debridement therapy and 53.8% in control group in 15 days. Maggot debridement therapy was found to have a significant effect in the first week and to make no significant difference on the 15th day (Opletalova et al. 2012). In other studies conducted, it has been determined that maggot debridement therapy results in as good or better than conventional surgical debridement, that it decreases patients' hospitalization times, wound healing time and major amputation risk (Gottrup and Jorgensen 2011, Marineau et al. 2011).

In conclusion, many studies have shown that maggot debridement therapy is an effective, easy, and cheap method of treating diabetic foot ulcers compared to conventional treatment and that it increases the healing rate of wound and shortens the healing period. However, new studies are needed to investigate the efficacy of maggot debridement therapy in different diabetic groups and large series.

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