

## THE USING OF *LUCILIA CUPRINA* MAGGOTS IN THE TREATMENT OF DIABETIC FOOT WOUNDS

By

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### Abstract

In the present study, *Lucilia cuprina* maggots were used for the treatment of diabetic foot wounds. An artificial wound was made in diabetic foot of rabbit. The maggots were sterilized and put directly on the wound after dressing the wound without using any antibiotics. Several cycles of maggots were put on the wound. The present results showed that the treatment of the diabetic foot was observed after 13 days. After this period the wound was completely healed and become free of microbial contamination. The new tissues were observed to close the wound.

**Keywords:** *Lucilia cuprina*, Maggots, Rabbit, Diabetic, Wounds, Treatment.

### Introduction

Maggot debridement therapy has been used for centuries. It was first acknowledged by military surgeons who noted faster healing of wounds with maggots (Baer, 1931). In the last years of the twentieth century, the maggot debridement therapy became more popular. Recently an increase in antibiotic resistant strains of bacteria and in diabetic foot and pressure ulcers (Sherman *et al*, 2000; Armstrong *et al*, 2002 and Bekins, 2010).

The debridement is defined as the removal of dead or necrotic tissue to prevent infection and to improve healing, to avoid wound delay which would provide a breeding ground for bacteria leading to gangrene, probable amputation and the possible septicemia (Bekins, 2010). Maggot's debridement has been suggested to work by mechanical and biochemical techniques (Mumcuoglu *et al*, 2001; Chambers *et al*, 2003). Maggots produce excretions and secretion (ES) that possess proteolytic enzymes that can dissolve the dead and/or infected matrix on the wound bed (Chambers *et al*, 2003). Maggots ES can prevent, inhibit, and break down biofilms of various bacteria (Cazander *et al*, 2009).

The present work aimed to study the using of *Lucilia cuprina* maggots in treatment of diabetic foot wounds in rabbits.

### Materials and Methods

The *Lucilia cuprina* (Diptera: Calliphoridae) were collected from Tonamel, Village, Aga Center, Al-Dakahlia Governorate, Egypt. Maggots were reared for several generation under controlled conditions of temperature  $26\pm 2^{\circ}\text{C}$ , relative humidity  $70\pm 10\%$  and 12-12 light-dark regime in the Research Laboratory of Medical Entomology, Faculty of Science, Al-Azhar University, Cairo. The identification of flies followed the pictorial key of Dodge (1953).

The animals used were female of New Zealand rabbits; they were reared in rabbit battery and daily provided with water and food. They weights were ranged from 1 kg to 2 kg. For prepare the diabetic rabbits the rabbit injected by alloxan (145 mg/Kg of rabbit) in marginal ear vein according to Etuk (2010). After injection, the rabbits were allowed to consume 10% glucose and fructose solution. After 48 h. and 120 h. from injection; The Sugar in blood measured was by Gluco-Dr (Blood glucose test meter). Hairs of rabbit's legs were removed firstly by shave machine

then hair removal cream. The wound (2 x 2 x 1 cm) was made by scalpel in the legs of rabbits; and left for 3 days to be contaminated then a piece of sponge was set around the wound. To prevent damage of the wound by rabbit mouth; two pieces from wood (15x20 cm) called Collar set around the neck of rabbit by doornails. The maggots of *L. cuprina* were washed by NaOH 9% then sterilized by ethyl alcohol 70% for 2 sec. After sterilization the maggots were placed on the wound as 5 to 10 maggots/cm<sup>3</sup> (Gottrup and Jørgensen, 2011) then dressed by clean Medical Gauze. Photographs of the wound were taken with a 16 megapixel digital camera.

### Results

Hairs of untreated diabetic rabbit's leg were removed, the wound was carried out (Fig. 1), and left for 3 days, to be contaminated (Fig. 2). After 2 days (Fig. 3), the healing of diabetic wound was delayed and with dirty smell, and the rabbit died on the 6<sup>th</sup> day due to the increased sugar level in blood (Hyperglycemia). The wound was made in legs of treated diabetic rabbit (Fig. 4) and left for 3 days to become contaminated (Fig. 5). *L. cuprina* maggots were placed on the diabetic wound and covered by dressing (1<sup>st</sup> cycle). In the 5<sup>th</sup> day, maggots were removed from the treated diabetic wound. The healing appeared to be start (Fig. 6). After 2<sup>nd</sup> cycle of maggots in the 6<sup>th</sup> day, the healing of the wound continued and new tissues were observed to be grown (Fig. 7). Healing continued in treating diabetic wound, as observed after the removal of the 3<sup>rd</sup> cycle of maggots on the 7<sup>th</sup> day (Fig. 8). Besides, more tissues healing were noticed grown after 4<sup>th</sup> cycle in the 8<sup>th</sup> day (Fig. 9). The diameter of treated diabetic wound is decreased after cycle 5 in the 9<sup>th</sup> day (Fig. 10). After the 11 days (7 cycles), 95% of the diabetic wound is healed (Fig. 11).

The completely healing of the wound was clearly observed after the 13<sup>th</sup> day (Fig. 12).

### Discussion

The maggot debridement therapy (MDT) has been shown as a safe and low cost-

effective treatment in contrast to the less selective surgical debridement and the use of expensive antibiotics (Gottrup and Jørgensen, 2011). Also, MDT has saved from amputation about 50% of limbs in which it has been tried (Sherman *et al.*, 2001; Jukema *et al.*, 2002; Sherman, 2002). In agreement with the present study, the maggot debridement therapy (MDT) with *Lucilia cuprina* proved as effective as the known conventional debridement in the treatment of diabetic wound where, Paul *et al.* (2009) used maggots of *Lucilia cuprina* for treating 29 patients suffered from diabetic foot wounds, 14 wounds were healed, 11 were unhealed and 4 were classified under others. The control group treated by conventional debridement had 30 patients of which 18 wounds were healed, 11 unhealed and 1 classified under others. Also, Kingu *et al.* (2012) and Tantawi *et al.* (2010) are suggested using *L. cuprina* in maggot debridement therapy. Bekins (2010) evaluated five studies, all showed that maggot debridement therapy was effective in debriding wounds; the present data was agreed with the author in the effectiveness of maggot debridement therapy in debriding wounds.

The present data showed an indication of using *L. cuprina* maggots in debriding the normal and diabetic wounds in rabbits (the wound debrided after 9 days and 13 days respectively). These results agreed with the results of Preuss (2004) in a case report of a 73-year-old woman suffered from necrotizing fasciitis of the neck, where he used MDT in this case, and the maggots perform three mechanisms of action: and clean wounds by dissolving dead and infected tissue, the maggots disinfected the wound, by killing the superimposed bacteria and the maggots stimulated the wound healing. Maggot debridement therapy (MDT) is used by a few small animal veterinarians to debride difficult wounds and proved useful for debriding and disinfecting some serious wounds (Sherman *et al.*, 2007).

The successful use of *Lucilia cuprina* maggot therapy went with the results reported in the

bull (Dicke, 1953), donkey (Bell and Thomas, 2001; Thiemann, 2003), dogs, cats and rabbits (Sherman *et al*, 2007) and horses (Sherman *et al*, 2007).

On the other hand, from medical point of view, Al-Wahbi (2006) reported that the prevalence of diabetic foot ulcers in the Arab world in general was high, compared with Western countries and that few studies illustrated the efficacy and associated healing mechanisms of local therapy of progenitor cells in a preclinical model of the diabetic ischaemic foot ulcer (Gu *et al*, 2007). El-Sharawy *et al*. (2012) in Egypt stated that diabetic patients with foot ulcers usually were manifested with high amputation and mortality rates and that treatment with the CD34+-enriched cells decreased wound size, accelerated epidermal healing and dramatically accelerated revascularization of wounds compared with the DC group. Assaad-Khalil *et al*. (2013) in Egypt stated that physicians in the Middle East and South Africa identified limitations relating to their patients as the main barrier to delivering care for diabetes, without giving high priority to issues relating to processes of care delivery. Further study would be needed to ascertain whether these findings reflect an unduly physician-centred view of their practice. More effective provision of services relating to the prevention of complications and improved lifestyles may be needed. El-Hilaly *et al*. (2013) in Egypt reported that in diabetic subjects, re-ulcerations following first ray amputations are particularly frequent and that treatment usually includes an in-shoe intervention to reduce plantar pressure. They concluded that the conforming total contact insole showed significant reduction in plantar pressures in patients with first ray amputation.

### Conclusion

Generally speaking, diabetic foot is more or less a worldwide complicated health problem as well as in the Arab countries including Egypt.

The outcome data recommended the using of *Lucilia cuprina* maggots in maggot debridement therapy in humans or animals wounds.

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Fig. 1: Untreated wound in diabetic rabbit leg at a zero day.

Fig. 2: Untreated wound in diabetic rabbit leg after 3 days, wound contaminated.

Fig. 3: Untreated wound in diabetic rabbit leg after 5 days, wound delayed in healing.

Fig. 4: Treated wound in diabetic rabbit with maggots at a zero day.

Fig. 5: Treated wound in diabetic rabbit with maggots after 3 days, wound contaminated

Fig. 6: Treated wound in diabetic rabbit with maggots after 5 days (one cycle), healing started.

Fig. 7: Treated wound in diabetic rabbit with maggots after 6 days (2 cycles). Post maggots' removal, healing appeared.

Fig. 8: Treated wound in diabetic rabbit with maggots after 7 days (3 cycles). Post maggots' removal, tissues continue healing.

Fig. 9: Treated wound with maggots after 8 days (4 cycles). Post removed maggots, tissues continued to heal and new layers of tissues appeared.

Fig. 10: Treated wound in diabetic rabbit with maggots after 9 days (5 cycles). Post maggots' removal diameter of diabetic wound decreased.

Fig. 11: Treated wound in diabetic rabbit with maggots after 11 days (7 cycles). Post maggots' removal and hard layer, new tissues' layers appeared.

Fig. 12: Treated wound in diabetic rabbit with maggots after 13 days (7 cycles), wound completely healed.

