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Clinical Report

Maggot Therapy for Snakebite Necrotic Wound in a Horse

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ABSTRACT

Maggot therapy is the use of sterile fly larvae in the treatment of superficial wounds in humans and animals. *Lucilia sericata* (Diptera: Calliphoridae) larvae are most commonly used for this purpose. Nowadays, larval therapy is widely used in the treatment of diabetic and infectious human wounds. Larval therapy in veterinary medicine has been used in dogs, cats, horses, and even ruminants. A 5-year-old crossbreed (Arabian and Kurdish) stallion was referred to a veterinary private sector in Tabriz city that suffered from a necrotic wound on its forelimb skin following a snakebite injury. The owner had seen the snake in the horse stable. Skin necrosis was observed on the dorsal of the right forelimb which extended to the ventral of the adjacent neck and chest. Despite this extensive skin injury, the horse was alert with a normal appetite and no sign of lameness was detected. Intravenous fluid therapy, systemic anti-inflammatory, and antibiotics were used for the horse's general condition support and topical oxytetracycline and zinc oxide were administered but had no effect on healing of necrotic wounds. Maggot therapy was performed on the necrotic skin. Unfortunately, the larvae died after inserting less than 24 hours. The maggot therapy was unsuccessful in the treatment of skin necrosis in this experience and the larvae died in this short time. However, more clinical trials on the efficacy of maggot therapy for extensive skin necrosis and studies on the effects of snake venom on the maggots are needed.

Case Description

A 5-year-old crossbreed (Arabian and Kurdish) stallion, weighing about 350 kg, with bay color was referred to a veterinary private sector in Tabriz city. Horse suffered from an extensive necrotic wound on its forelimb skin with dyspnea. The condition was occurred suddenly and the skin lesions got bigger within 24 hours. The owner had seen the snake in the horse stable. Skin necrosis was observed on the dorsal of right forelimb which extended to the ventral of the adjacent neck and chest (Figure 1A). Despite this extensive skin injury, the horse was alert with normal appetite and no any sign of lameness was detected.

Treatment and Outcome

A supportive treatment was considered initially. Intravenous fluid therapy was performed with 10 liters

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of Ringer's solution every 12 hours for one week. Systemic flunixin meglumine (1.1 mg/kg, IM, q24h, Flonex 5%, Razak Pharmaceutical Co., Tehran, Iran) for three days, penicillin G procaine (5000000 IU, IM, q12h, Logexin, Razak Pharmaceutical Co., Tehran, Iran) and gentamicin (2.5 mg/kg, IM, q12h, 5%, Razak Pharmaceutical Co., Tehran, Iran) was given to the horse for 5 days. The skin wound was washed twice daily with a sterile normal saline containing 2% povidone iodine for one week. Topical oxytetracycline and zinc oxide were administered but had no effect on healing of necrotic wounds (Figure 1B). Although the animal's general condition improved during treatment, necrotic skin lesions were still present and showed no signs of healing. To debridement of wound and help to start the granulation tissue growing, maggot debridement therapy (MDT) was suggested.

Three days after the end of the customary treatment period, MDT was started. Sterile larvae used in medical MDT (*L. sericata*) were obtained from the larval therapy center of Tehran University of Medical Sciences. To keep the larvae alive, special packages of sterile larvae were flown to the Tabriz International Airport .Wounds were gently washed with normal saline before larval treatment. MDT was performed in two ways on wounds. One of the most severe necrotic sites was selected and a dressing was done to restrain the larvae. In other parts of the wound, the larvae were placed freely on the wound. A piece of sterile mesh and a light dressing were placed on the artificial nest created for the larvae. The dressing was supported by a support attached to the around of horse's chest to prevent it from falling (Figure 1C and D).

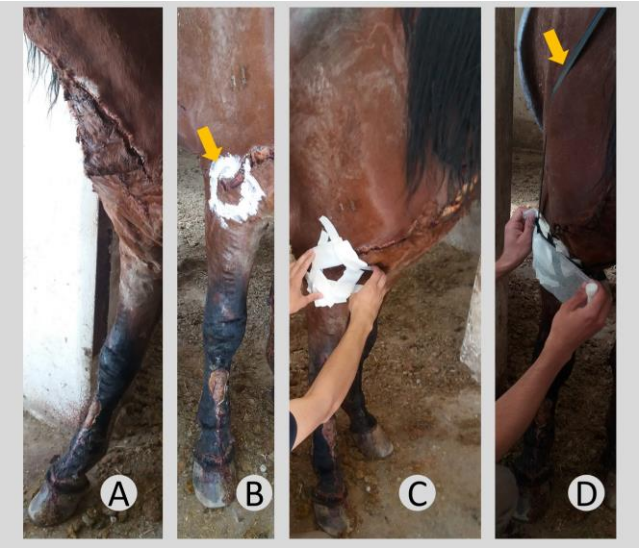

Figure 1. Snakebite necrotic wound and its maggot therapy. A: Medial view of the lesion. B: Front view of the lesion and rubbing zinc oxide (arrow) around the maggot debridement therapy site. C: Artificial nest structure for larvae. D: Paste a sterile mesh and attach the dress.

Free larvae on the wound died one day later. The size of the larvae did not seem to change during this time. Seeing this situation, the dressing was opened on the second day. The larvae placed in the artificial nest (dressing) were also dead like free-ranging larvae and no significant growth was observed in their size.

Clinical Relevance

The use of sterile fly larvae to treat superficial lesions in humans and animals is called maggot therapy. Since the time of the Mayan Indians and some Spanish tribes and Greek, this method has been used to treat various wounds such as war wounds. The microbial resistance created by antibiotics and the community's desire for natural remedies have provided opportunity to use this method.[1].The US Food and Drug Administration (FDA) approved the method in 2003 for the treatment of human wounds.[2] The most used larvae in maggot therapy are *Lucilia sericata* larvae (LSL), which belongs to the Calliphoridae family. LSL does not invade living tissue and this has led to the larvae receiving more attention than others.[3]

The main advantage of LSL is debridement and removal of necrotic debris from the wounds. Contact of larval thin hairs with body cells causes more exudate to be secreted into the wound and accelerates healing.[4] LSL is a genetic pathway that promotes angiogenesis and improves wound blood flow.[5] Maggot secretions have antimicrobial, antioxidant and anti-inflammatory properties. Maggots regulate the immune system, regulate fibroblast growth, strengthen coagulation and repair nerves.[6–8]

The results of larval therapy are faster and sometimes more effective than conventional treatments. LSL is photophobic and penetrates deep into the wound.[3,4] Larval therapy has been performed in special centers in Iran for several years.[9] Maggot debridement therapy is mostly used in the complementary treatment of human diabetic wounds and infected wounds in animals. The effectiveness of larval therapy in the treatment of pressure ulcers, vascular and surgical wounds has also been proven.[10–12]

MDT has been used in dogs, cats and rabbits as substitute procedure to prevent amputation or euthanasia.[13] MDT had a positive effect on wound healing in sheep.[12] MDT in the early stages of

actinomycosis in a cow was able to quickly heal the lesion.[14] It seems that MDT in horses has been done more than others. In a report of 41 equid, including horses, ponies, and donkeys that received maggot therapy, reportedly only three of them were failed to completely healing. Also, there are reports that shows insults like fistulous withers, keratoma, septic navicular bursitis, septic pedal bone osteitis, bulb laceration, limb lacerations, chronic proliferative wounds, fistulation of chronic tuber coxae fracture, cannon bone fracture with methicillin-resistant staphylococcus aureus infection, soft tissue abscess, complementary therapy in *linea alba* surgical intervention in horse which treated with MDT.[15] Chronic laminitis, navicular bursitis, puncture wounds, digital flexor tendon tendinitis, coffin joint arthritis/osteomyelitis, fistulation/necrosis of collateral cartilage, distal interphalangeal sepsis and canker successfully treated in horses using MDT.[16–19] Today, in modern maggot therapy, the risk of transmitting the disease from magots to the patient has been eliminated,[20] but adverse reactions to MDT are uncommon and only discomfort and rubbing of the skin were seen in some horses.[15,16,18]

Based on previous successful experiences in the treatment of necrotic wounds in horses, this method seemed to be useful for necrotic wounds caused by snake bites.

Horses are more susceptible to snake venom than other animals.[21] The symptoms seen in our experience was comparable to the constant finding of signs of snakebite in horses. In one report of nine snakebites in horses in Brazil, there were six cases with respiratory distress, all of nine showed cellulite and necrosis at the site of the bite.[22] An epidemiological study of necropsy findings in bitten horses found myonecrosis and dermonecrosis to be the predominant symptoms.[23] Dyspnea, swelling and tissue necrosis are symptoms of snakebite in horses. Cytolisins are a type of toxin in snake venom that can cause tissue necrosis in animals.[21]

In our present case, both methods of placing the larvae in the artificial nest and releasing it freely in the wound were used according to the previous studies.[14,18] Although none of the complications mentioned in previous horse larval treatments were observed in this case, the early death of the larvae on the wound prevented the expected desired result.

There are reports of myasis in snakebite wounds, which could indicate the ability of larvae to live in snakebite wounds.[24,25] Of course, the difference in the type of snakes and their venom on the one hand and the difference in the species of fly larvae on the other hand, can be an influential factor in this case. As none of the reported myasis in snakebite wounds were LSL. A study have shown that the antibiotics clindamycin, vancomycin, and daptomycin do not kill larvae.[26] However, use of systemic antibiotics (penicillin and gentamicin) or topical povidone iodine to treat necrotic wound in the present case may have caused larval death because they are different from the antibiotics in the previous study. The effect of these substances on larval death cannot be conclusively accepted or rejected and needs further study.

There are anecdotal evidences of the use of MDT in snakebite wounds in horses. Although in some cases it has been claimed that MDT has been effective in healing these wounds, a number of authors have also referred to the death of larvae due to snake venom in the wound.[27,28]

In one study, the venom of nine species of snakes caused flaccid paralysis in flies and larvae of the Califoridea family, but the venom of the Elapidae snake was more toxic than the others. Lytic enzymes may have been involved in the observed effects.[29] In one study, larval therapy with *Lucilia eximia* had no significant effect on wound healing from venom of Bothrops asper in mice.[30] The results of these studies may be justifying the negative result of the therapy in our experience.

Despite the discomfort in some horses, MDT is an effective method of wounds treatment in equine. Skin injuries are common due to the working and athletic nature of horses, and larval therapy can also help treat these wounds. This method is effective in wounds that do not respond to common conventional treatments. Hoof and frog lesions which are common movement problems in horses, can be quickly treated with MDT. In spite of unsuccessful result in the treatment of horse's skin wounds which caused by probable snake bites more investigation should be performed on the MDT in horses.

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Conflict of Interest

The authors declare no conflicts of interest related to this report.

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