

ORIGINAL ARTICLE

The Effect of Bacterial Colonization and Maggot Debridement Treatment on Wound Healing in Chronic Venous Leg Ulcers

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SUMMARY

Background: The debridement of necrotic and infected tissues, which prolong the wound healing process, is important for the preparation of the wound bed. Therefore, wound-bed preparation and debridement are vital components of venous leg ulcer management. We aimed to present a perspective to evaluate the clinical and microbiological efficacy of Maggot Debridement Therapy (MDT) in the treatment of chronic leg ulcers caused by venous insufficiency.

Methods: Thirty-eight patients with chronic venous leg ulcers who were referred to our unit with an MDT request were included in the study. *Lucilia sericata* larvae were applied to the wounds two days a week until the necrotic tissue was cleared. Swab samples were regularly taken before and immediately after each larval application for wound culture. Changes in the percentage of wound surface area and growing pathogenic microorganisms were recorded during the follow-up period.

Results: The sample consisted of 38 patients with 55 venous leg ulcers. The mean initial ulcer surface area was 99.1 cm² (range 3 - 500). Complete debridement was achieved in all ulcers in the 2nd week, on average. Twenty-five ulcers (45.5%) were completely debrided with two one-week MDT sessions. Complete wound healing occurred in 42 ulcers (76.4%) after an average of seven MDT sessions. Microorganisms isolated from the wounds significantly decreased immediately after the first MDT session.

Conclusions: Although many methods are used in the treatment of venous leg ulcers, they are often not effective. MDT, which is coming into widespread use today, is a simple and effective method in the treatment of these ulcers. Its effects such as biodebridement, disinfection, and growth stimulation can encourage the rapid healing of chronic venous leg ulcers.

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KEY WORDS

venous leg ulcers, maggot debridement therapy, venous insufficiency, microorganisms

INTRODUCTION

Leg ulcers caused by venous insufficiency are chronic and recurrent wounds. Venous leg ulcers (VLUs) are quite common in the population and the incidence rate in individuals over the age of 80 is 4 - 5% [1,2]. It takes

weeks or months to heal leg ulcers that have high diagnosis and treatment costs and can cause labor loss and serious deterioration in the quality of life [3].

Treatment of venous leg ulcers aims to reduce venous lower extremity pressure and provide a wound environment that promotes healing. The debridement of necrotic and infected tissues, which prolong the wound healing process, is important for the preparation of the wound bed [4]. It is also very important to heal the wound by reducing its diameter, prevent bacterial colonization and infection, and accelerate epithelization by stimulating wound granulation [5].

Larval therapy (also known as 'maggot therapy' or 'therapeutic myiasis') applied using sterile larvae belonging to the *Lucilia sericata* fly species has been successfully used in the treatment of chronic and persistent wounds for many years. These larvae, which do not harm healthy tissues, dissolve necrotic tissues with the enzymes they secrete and disinfect the wound by eating, killing, and stopping the growth of microorganisms. Besides, they accelerate the healing of chronic wounds by stimulating granulation [6-9].

In this study, we aimed to present a perspective to evaluate the effect of Maggot Debridement Therapy (MDT) on wound healing by evaluating the bacterial culture results obtained from patients with chronic venous leg ulcers who applied to our unit for larval treatment or were referred to our unit.

MATERIALS AND METHODS

Study design and patients

The results of 38 patients with chronic venous leg ulcers who applied or were referred to Istanbul University-Cerrahpasa, Biotherapy Research and Development Laboratory between January 2016 and January 2020 with an MDT request were retrospectively analyzed. The personal demographic data of the patients were included in the study such as age and gender, and the data regarding the results of the requested wound culture were recorded.

The MDT protocol

The patients were treated with MDT an average of 14 times, twice every 3 days in the first 4 weeks, once in the next 4 weeks and once in the last 2 months, until the necrotic tissue in the wound was cleared. Sterile *L. sericata* larvae, which were placed directly on the wound at 8 - 10 larvae per cm², were covered with a sponge, and patients were advised to change the dressing frequently not to leave the wound wet. Larvae were removed after keeping them on the wound for 48 - 72 hours.

Bacteriological analysis

For microbiological culture, swab samples were taken regularly before and immediately after each larval application until recovery was achieved or treatment was completed. Routine conventional methods were used to

identify clinically important bacteria. After identifying the bacteria isolated by cultivating on blood agar, chocolate agar, and MacConkey agar, all agents were examined in terms of antibiotic susceptibility.

Statistical analysis

The evaluation of the data of the patients was done with Microsoft Excel version 2013 and IBM SPSS Statistics for Windows, Version 25 (IBM Corp. Armonk, NY, USA. Released 2017) package program. Descriptive statistics such as mean \pm standard deviation (SD) were used to define the age of the patients, and frequencies (n) and percentages (%) were used to describe gender and microbiological culture test results. The chi-square test was used to compare numerical data, and a p-value below 0.05 was considered statistically significant.

Ethical considerations

The approval for the study was granted by the Ethics Committee of Istanbul University, Cerrahpasa Medical Faculty with the ID number of 14620 and informed consent was given by all study participants. The study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

Of the 38 patients included in the study, 27 were male (71.05%) and 11 (28.95%) were female. The mean age of the patients between the ages of 28 and 71 was calculated as 54.13 ± 12.23 years. The age, gender of the patients, and the characteristics and localization of the wounds are shown in Table 1.

The sample comprised 38 patients with 55 venous leg ulcers. The mean baseline ulcer surface area was 99.1 cm² (range 3 - 500). Complete debridement was achieved in all ulcers in a mean of 2 weeks. Twenty-five ulcers (45.5%) were completely debrided with two one-week MDT cycles. Full wound healing occurred in 42 ulcers (76.4%) after a mean of seven MDT sessions. Forty-eight of the wounds had a mixed bacterial population ranging from one to six. No bacteria reproduced in the culture of the seven wounds. A total of 113 bacteria and two yeasts, 41 of which were gram-positive and 72 gram-negative, were isolated from 55 wounds (Table 2). The microorganism load of all ulcers significantly decreased immediately after the first MDT session. Our results indicate that MDT rapidly debrides necrotic tissue and significantly reduces microorganisms isolated from wounds.

DISCUSSION

VLUs are chronic and recurrent problems that are costly for the healthcare system and significantly adversely affect patients' quality of life [10]. Compression, dressing, and surgical debridement are the mainstay of venous ul-

Table 1.

Patient characteristics (n = 38)	
Age (years)	54.1 (28 - 71)
Female : male	11 : 27
Duration of venous ulcer (years)	4.4 (1 - 25)
Ulcer characteristics (n = 55)	
Surface area (cm ²)	99.1 (3 - 500)
Duration (months)	47.7 (1 - 300)
Anatomical location	
Gaiter area	21
Lateral malleolus	13
Lower calf	13
Tibial area	5
Perimalleolar area	3
Clinical outcomes of MDT	
Duration of therapy (weeks)	6.1 (1 - 36)
Number of ulcers that close	42
Time to complete closure (weeks)	5 - 27

Table 2.

Bacteria (n = 113)	No. of isolates
<i>Pseudomonas aeruginosa</i>	23
<i>Staphylococcus aureus</i>	16
<i>Proteus mirabilis</i>	15
<i>Corynebacterium spp.</i>	9
<i>Enterobacter spp.</i>	8
Coagulase-negative staphylococci	7
<i>Escherichia coli</i>	6
<i>Acinetobacter spp.</i>	5
<i>Klebsiella spp.</i>	4
<i>Serratia marcescens</i>	4
<i>Stenotrophomonas maltophilia</i>	4
Other gram-negatives	7
Other gram-positives	5
No growth	7

cer treatment. However, surgical and aggressive wound debridement methods are not suitable for all patients and are not always effective [11].

Larvae, also known as bio-surgeons, perform surgical intervention without damaging healthy tissues like an experienced doctor [12]. The mechanism of action of MDT includes the cleansing of necrotic tissues (bio-de-

bridement), prevention of bacterial colonization and infection (disinfection), stimulation of wound granulation, and acceleration of epithelization (growth stimulation) [13]. Several clinical benefits of MDT, widely used in recent years, have also been defined in the treatment of VLU's [11,14-17].

Many non-surgical conventional methods (wet-dry gauze dressing with saline, topically-applied betadine, compression therapy, hyperbaric oxygen therapy, systemic antibiotics, etc.) were previously applied to all the patients with chronic venous leg ulcers, who were admitted or referred to our unit with an MDT request; however, no improvement had been achieved with these treatments. Our results show that MDT rapidly debrides necrotic tissue and significantly reduces microorganisms isolated from wounds. Larval treatment is increasingly used to accelerate healing due to its role in reducing the bacterial load in wounds, as well as being an effective debriding agent [18-20].

The larvae secrete digestive enzymes into the wound bed and debride necrotic tissue effectively and rapidly, as well as digesting bacteria, causing a decrease in the bacterial load. In addition, fibroblast formation increases due to the growth factors secreted by the larvae and the mobility of the larvae in the wound bed, which accelerates wound healing [20-22]. Complete debridement was achieved in all ulcers in the 2nd week, on average. Twenty-five ulcers (45.5%) were completely debrided with two one-week MDT sessions. Complete wound healing occurred in 42 ulcers (76.4%) after an average of seven MDT sessions. These results are consistent with the study of Dumville et al. [23] with 267 participants, which demonstrates the superiority of larval-assisted wound debridement over hydrogel in necrotic leg ulcers. It is in line with the findings of a case report by McInnes et al. [11] in 2013, which reports that it is associated with facilitating debridement and reduction of bacterial load in bilateral leg ulcers complicated by abnormally high bacterial load and the presence of multi-drug resistant organisms.

As shown in these data and previous studies, MDT promotes the formation of granulation tissue by helping to selectively debride necrotic tissues. In addition, it contributes to the prevention of infection by reducing the bacterial load. A clean wound bed with healthy granulation tissue, free of necrotic tissue, and reduced bacterial colonization promotes rapid healing of chronic venous leg ulcers.

Although MDT alone does not promise a definitive cure for chronic venous leg ulcers, it renders it possible and accessible. In other words, the favorable results of larval treatment applied as an alternative to conventional treatment for chronic venous leg ulcers that respond poorly to conventional therapy are indicative of significant progress towards recovery.

More randomized controlled research is required to investigate the relationship between debridement, healing, and microbiology and to better understand the healing effect of MDT on chronic venous leg ulcers.

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Declaration of Interest:

None declared.

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