International Journal of Surgery Case Reports 99 (2022) 107723

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.elsevier.com/locate/ijscr

Case report

Surgical debridement and maggot debridement therapy (MDT) bring the light of hope to patients with diabetic foot ulcers (DFUs): A case report

Naser Parizad [a], Kazem Hajimohammadi [b], Rasoul Goli [c,*], Yousef Mohammadpour [d], Navid Faraji [c], Khadijeh Makhdomi [e]

[a] Patient Safety Research Center, Urmia University of Medical Sciences, Urmia, Iran
[b] Imam Khomeini Teaching Hospital, Urmia University of Medical Sciences, Urmia, Iran
[c] Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Urmia University of Medical Sciences, Urmia, Iran
[d] Department of Medical Education, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran
[e] Department of Nephrology, Faculty of Medicine, Urmia University of Medical Science, Urmia, IR, Iran

ARTICLE INFO

Keywords:
Diabetic foot
Larva
Debridement
Patient
Case report

ABSTRACT

Introduction and importance: Management of diabetic foot ulcers (DFUs), one of the complications of diabetes mellitus, can lead to death and amputation, and it is one of the most critical challenges for the patients and their families.

Case presentation: The present case report concerns a 72-year-old man with a 5-year history of uncontrolled type 2 diabetes mellitus. The patient had antibiotic-resistant DFUs on two phalanges of his left foot, which were completely gangrenous, and a superficial ulcer of 1 × 1 cm under his left foot. Despite the routine DFU care, the phalanges of his DFU were amputated. The patient was moved to our wound management team. DFU was treated and managed using surgical debridement and maggot debridement therapy. Ten sessions of Maggot Debridement Therapy (MDT) were conducted (one therapy session every 48 h). After three months, the patient's DFUs healed, and he was discharged from our service in good condition.

Clinical discussion: DFU can lead to infection, amputation, and even patient death. Therefore, effective treatment methods are very important for managing DFUs.

Conclusion: Using surgical debridement and MDT is a safe and effective approach to facilitate the healing of DFUs.

1. Introduction

Approximately 422 million people worldwide have been affected by diabetes, including 8.5 % of the population [1]. The incidence of diabetes has a fast incremental trend in low- and middle-income societies. Around 25 % of the total diabetic population will develop a diabetic foot ulcer (DFU) during their lifespan [2]. Infection is one of the most important factors derived from DFU complications, which can significantly influence revenue across communities and countries [3]. Caring for DFU accompanied by infection and subsequent antibiotic therapy burdens all countries [4]. In diabetic individuals, high blood sugar, even in a short time, can substantially lead to debilitating inherent immune function. Hence this situation increases susceptibility to developing DFU along with mild to severe ulcer site infection [5].

The standard treatments for DFU include various local and systemic approaches, such as proper blood sugar maintenance, debridement of dead tissue, wet dressing, nutritional support, antibiotic therapy, and surgical amputation [3]. Innovative and modern methods to precipitate the process of wound healing are considering Maggot Debridement Therapy (MDT), Negative Pressure Wound Therapy (NPWT), Hyperbaric Oxygen Therapy (HBOT), stem cell-based therapy, growth factor therapy, and therapeutic application of extracellular matrix protein [6,7].

Chronic wounds can be treated successfully without expensive medicines using MDT [3]. It is an old remedy using fly larvae (maggots) to remove dead tissue, control infection, and promote wound healing [8]. One of the unconventional methods for DFUs management is the therapeutic use of fly larvae, referred to as 'maggots', for wound treatments [3]. MDT is the clinical utilization of sterilized medical worms grown under controlled laboratory conditions intentionally, with difficult quality control procedures [9]. These creatures can lead to the debridement of non-viable tissue, reduce the wound surface area and precipitate the duration of the healing process [10].

* Corresponding author at: Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Urmia University of Medical Sciences, Urmia, Iran.
E-mail addresses: Rasoulgoli94@gmail.com, Goli.r@umsu.ac.ir (R. Goli).

https://doi.org/10.1016/j.ijscr.2022.107723
Received 27 August 2022; Received in revised form 28 September 2022; Accepted 29 September 2022
Available online 5 October 2022

Regarding that DFUs do not respond to standard wound care therapies, MDT is recommended for managing and treating DFUs [4]. This case report represents a patient with DFU who recovered using surgical debridement and MDT. This case was reported in line with the SCARE 2020 Guidelines [11].

2. Case presentation

This patient is a 72-year-old man with a 9-year history of type 2 diabetes who has had left DFUs for two years. He is also an employee of the water department with a middle-level socioeconomic status. So far, he has been hospitalized five times for the routine treatment of DFU, including normal saline wound dressing and antibiotic therapy. He indicates poor glycemic control and has a history of high blood pressure; the patient also has a family history of diabetes and hypertension. In addition, to control blood sugar, he has been on Novorapid insulin for five units q8h(TDS), and Lantus Insulin for 27 units at night before bedtime for five years. Moreover, he was taking Metformin 500 mg and Captopril 25 mg tablets q12h (BID). He is not a smoker and denies any drug and alcohol abuse in the past. He is also from a middle-income family.

The patient had referred to Imam Reza Hospital in Urmia on 11 June 2020 with a chief complaint of ulceration on the left foot. In addition, it was found that the patient had antibiotic-resistant DFUs on two phalanges of the left foot, which were completely gangrenous and a superficial ulcer of 1 × 1 cm under his left foot (Fig. 1). During hospitalization, he first received an intravenous (IV) infusion of 400 mg Ciprofloxacin q12h (BID) and Clindamycin 900 mg q8h (TDS) for four days, and then he received an IV infusion of Meropenem 1 g IV TDS and Vancomycin 1 g IV BID for two weeks. The patient's DFU also had an annoying odor. The severity of the diabetic foot infection was such that the patient suffered from sepsis symptoms (fever, chills, tachycardia, and hypotension). The patient's vital signs on admission were as follows: Temperature: 38.8 °C, Respiration Rate: 23 bpm, Pulse Rate: 113 bpm, Blood Pressure: 150/85 mmHg. The patient underwent an initial examination, Color Flow Doppler, and Magnetic Resonance Imaging (MRI). The findings show abnormalities in the foot's circulatory system and approved the presence of peripheral arterial disease (PDA). Moreover, the results of the MRI confirmed the diagnosis of osteomyelitis. Moreover, the Ankle Brachial Index (ABI) confirmed the presence of lower-extremity PAD.

The osteomyelitis was examined in the patient's foot by Color Doppler Imaging (CDI) and Magnetic Resonance Imaging (MRI). In addition, imaging examination of the limb showed numerous small and calcified atheroma that had led to multiple arterial stenoses. Unfortunately, the patient did not recover from DFU using conventional methods, although he received treatments including antibiotic therapy and normal saline dressing (TDS). The patient was asked for orthopedic consultation, based upon which he became a candidate for foot amputation.

In our wound-care center, a wound swab sample was obtained from the ulcer under sterile conditions and was sent to the microbiology department of Imam Khomeini Hospital within 1 h after sampling. The sample was then cultivated for aerobic and anaerobic organisms. The culture antibiogram obtained from DFUs showed drug resistance to *S. aureus* and *E. coli* (Table 1).

Concerning the presence of necrotic and infectious tissue, surgical debridement of DFUs was initially performed by a surgeon on 20 August 2020. Then the larvae of L. *sericata* were prepared under a sterile situation, and he underwent MDT. Maggots were supplied from the medical entomology laboratory of the Public Health School at Tehran University of Medical Sciences, Iran. These larvae eat dead tissue and bacteria at the wound site and release antimicrobial enzymes that enhance wound healing. MDT was conducted in four steps: wound preparation, applying larvae to the wound, hydrocolloid dressing, and removing larvae after 48 h (Fig. 2). Wound preparation was done by placing the surgical drape on the patient's wound and irrigating it with physiological saline. At each phase of the intervention, the patient was inquired a query about tolerating the MDT and continuing the intervention every twenty minutes. If the response was "yes," the intervention was continued, but if the answer was "no," the intervention was stopped. Overall, ten sessions of MDT were conducted (one session every 48 h). After beginning the MDT, the odor of the infection completely ended. The procedures were performed by a nurse (first author) who was trained and certified in this field. After completing the MDT, the patient's DFUs were utterly healed after three months (Fig. 3), and the patient was discharged from our service with a good and stable general condition.

3. Discussion

Diabetes mellitus is one of the most influential chronic conditions in which blood sugar levels rise abnormally [2]. There are a variety of complications with diabetes that can broadly affect the physical, personal, and even social aspects of life [4]. A DFU is tissue damage with an open wound situation that constitutes approximately less than a fifth of diabetic patients and generally is located on the bottom of the foot [9]. Outcomes and consequences of care negligence could lead to

Table 1
The results of the patient's wound culture.

Wound culture	Results
Culture	*Staphylococcus aureus & E. coli*
Sensitive	Imipenem - Meropenem - Ceftriaxone
Intermediate	Trimethoprim-Sulfamethoxazole
WBC	3–5
RBC	2–3
Bacteria	Moderate

Fig. 1. Diabetic foot ulcer before starting MDT.

Fig. 2. Diabetic foot ulcer after MDT.

Fig. 3. Healing the DFU by MDT.

hospitalization because of infection, which is called diabetic foot infection (DFI). If DFI remains untreated, a severe condition, such as septicemia, can threaten the patient, and even death of the affected person is feasible [6]. Hence, for managing and controlling DFI, a variety of methods and wound bandaging have been applied [12].

MDT is becoming increasingly established as an option for the debridement and treatment of sloughy, necrotic wounds. The cost of an initial maggot treatment will vary depending on how many maggots are needed. However, reports suggest that using maggots is, in fact, a very cost-effective wound treatment [4].

In line with the present case report study results, Malekian et al. (2019) conducted a clinical trial on the effect of MDT on DFU and indicated that MDT is a safe and effective treatment method for DFU [8]. In addition, Siavash et al. (2020) concluded that MDT is an effective and new treatment for complex DFUs which are resistant to conventional and routine therapies [10]. Moreover, similar to our report, Parizad et al. (2021) showed that the combined use of MDT, surgical debridement, silver dressing, and NPWT is very effective in treating refractory DFUs [13]. In addition, Hajimohammadi et al. (2021) reported that combining surgical debridement and MDT is a safe and effective strategy for treating diabetic foot ulcers and preventing amputation [14]. Choobianzali et al. (2022) reported that MDT is an affordable and highly efficacious treatment approach to enhance the recuperation of DFUs [4].

4. Conclusion

Infectious DFUs cause irreparable damage to the patient's performance and quality of life. Thus, effective treatment approaches are required for the management of DFUs. This case report showed that using surgical debridement and MDT is a safe and effective approach to facilitate the healing of DFUs.

Sources of funding

None.

Ethical approval

IR.UMSU.REC.1401.208

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Research registration

Not applicable.

Guarantor

Rasoul Goli

Provenance and peer review

Not commissioned, externally peer-reviewed.

CRediT authorship contribution statement

Rasoul Goli: Study concept, data collection, writing the paper and making the revision of the manuscript following the reviewer's instructions. Naser Parizad: Study concept, reviewing and validating the manuscript's credibility. Kazem Hajimohammadi: reviewing and

validating the manuscript's credibility.

Declaration of competing of interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijscr.2022.107723.

References

[1] N. Faraji, R. Goli, B. Choobianzali, S. Bahrami, A. Sadeghian, N. Sepehrnia, M. Ghalandari, Ozone therapy as an alternative method for the treatment of diabetic foot ulcer: a case report, J. Med. Case Rep. 15 (1) (2021 Dec) 1–8, https://doi.org/10.1186/s13256-021-02829-y.

[2] M. Arad, R. Goli, M. Ebrahimzade, M. Lorzini, M. Abdali, N. Sepehrnia, Ending surgical site infection by Negative Pressure Wound Therapy (NPWT): a case report, Int. J. Surg. Case Rep. 1 (94) (2022 May), 107080, https://doi.org/10.1016/j.ijscr.2022.107080.

[3] F. Stadler, The maggot therapy supply chain: a review of the literature and practice, Med. Vet. Entomol. 34 (1) (2020) 1–9, https://doi.org/10.1111/mve.12397.

[4] B. Choobianzali, R. Goli, A. Hassanpour, M. Ghalandari, R. Abbaszadeh, Reviving hope by using of maggot debridement therapy in patients with diabetic foot ulcer: a case report study, Int. J. Surg. Case Rep. 1 (91) (2022 Feb), 106797, https://doi.org/10.1016/j.ijscr.2022.106797.

[5] N. Parizad, K. Hajimohammadi, A. Hassanpour, R. Goli, Treating surgical site infection by honey antibacterial wound dressing in a neonate: a case report, Br. J. Nurs. 31 (4) (2022 Feb 24) S8–S14, https://doi.org/10.12968/bjon.2022.31.4.S8.

[6] N. Faraji, R. Goli, M. Ghalandari, S. Taghavinia, B. Malkari, R. Abbaszadeh, Treatment of severe extravasation injury in a newborn by using tilapia fish skin: a case report, Int. J. Surg. Case Rep. 1 (91) (2022 Feb), 106759, https://doi.org/10.1016/j.ijscr.2022.106759.

[7] R. Goli, N. Faraji, S. Shakorzadeh, M. Abbasi, R. Abbaszadeh, B. Mostafaei, Treating extravasation injury by honey antibacterial wound dressing in a neonate: A case report, International Journal of Surgery Case Reports 4 (2022) 107279, https://doi.org/10.1016/j.ijscr.2022.107279.

[8] A. Malekian, G.E. Djavid, K. Akbarzadeh, M. Soltandallal, Y. Rassi, J. Rafinejad, A. R. Foroushani, A.R. Farhoud, R. Bakhtiary, M. Totonchi, Efficacy of maggot therapy on staphylococcus aureus and pseudomonas aeruginosa in diabetic foot ulcers: a randomized controlled trial, J. Wound Ostomy Cont. Nurs. 46 (1) (2019) 25–29, https://doi.org/10.1097/WON.0000000000000496.

[9] C. King, Changing attitudes toward maggot debridement therapy in wound treatment: a review and discussion, J. Wound Care 29 (Sup2c) (2020 Feb 1) S28–S34, https://doi.org/10.12968/jowc.2020.29.Sup2c.S28.

[10] M. Siavash, A. Najjarnezhad, N. Mohseni, S.M. Abtahi, A. Karimy, M.H. Sabzevari, Efficacy of maggot debridement therapy on refractory atypical diabetic foot ulcers: an open-label study, Int. J. Low. Extrem. Wounds 5 (2020 May), 1534734620920403, https://doi.org/10.1177/1534734620920403.

[11] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, A. Thoma, et al., The SCARE 2020 guideline: updating consensus Surgical CAse REport (SCARE) guidelines, Int. J. Surg. 1 (84) (2020 Dec) 226–230, https://doi.org/10.1016/j.ijsu.2020.10.034.

[12] J.J. Hurlow, G.J. Humphreys, F.L. Bowling, A.J. McBain, Diabetic foot infection: a critical complication, Int. Wound J. 15 (5) (2018) 814–821, https://doi.org/10.1111/iwj.12932.

[13] N. Parizad, K. Hajimohammadi, R. Goli, Surgical debridement, maggot therapy, negative pressure wound therapy, and silver foam dressing revive hope for patients with diabetic foot ulcer: a case report, Int. J. Surg. Case Rep. 1 (82) (2021 May), 105931, https://doi.org/10.1016/j.ijscr.2021.105931.

[14] K. Hajimohammadi, N. Parizad, A. Hassanpour, R. Goli, Saving diabetic foot ulcers from amputation by surgical debridement and maggot therapy: a case report, Int. J. Surg. Case Rep. 1 (86) (2021 Sep), 106334, https://doi.org/10.1016/j.ijscr.2021.106334.