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Case report

Large wound surgery of diabetic foot ulcer with Split-thickness skin graft (STSG), and maggot debridement therapy (MDT): A case report

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ABSTRACT

Introduction and importance: Diabetic foot ulcers (DFUs) as one of the complications of diabetes mellitus (DM) can lead to death.

Case presentation: The present case reports a 56-year-old woman with an 11-year history of type 2 diabetes who has had left DFUs for two years. The patient had antibiotic-resistant DFUs her left foot, which were completely gangrenous and a superficial ulcer up and under her left foot. Despite the routine DFU care, the patient did not recover from DFU using standard methods. The patient was referred to our wound management team. DFU was treated and managed using split-thickness skin graft (STSG) and surgical debridement, maggot debridement therapy (MDT). After two 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: This case report study was shown that the combined use of STSG, surgical debridement, and MDT is a safe and effective approach to improve the healing of DFUs and prevent foot amputation.

1. Introduction

Diabetic foot ulcer (DFU) is known as one of the most important complications that is highly likely to occur in a large proportion of the diabetic community, affecting 25 % of the total population diagnosed with diabetes mellitus [1]. The treatment of DFU associated with infection and subsequent antibiotic therapy is a burden for all countries [2].

Current methods of treating DFU include debridement of necrotic tissue, wound care and exudate management, negative pressure wound therapy (NPWT), antibiotic therapy, silver foam dressing, maggot therapy (MT), hyperbaric oxygen therapy (HBOT), stem cell-based therapy, growth factor therapy, and therapeutic application of extracellular matrix proteins [3,4]. Maggot debridement therapy (MDT), also known as larval therapy, falls into the category of bio-therapy because experts use live animals to remove the necrotic tissue around the wound [5]. The ability of these larvae to clean and remove dead tissue can be compared to other debridement methods [6]. In addition, sharp debridement is another therapeutic invasive procedure [7]. A modern definition for this method is: removal of dead tissue or foreign material from and around an ulcer to expose healthy tissue for the next stage of treatment [5]. To accelerate the healing process in DFU, another option is split-thickness skin graft (STSG) [8]. This complementary method is used together with other treatments to achieve good results [9]. An STSG, also called a partial graft, includes the epidermis and part of the dermis [8].

Considering that DFUs do not respond to conventional wound care approaches, complementary and combination therapy is recommended for the treatment of DFUs [10]. This case report presents a patient with DFU who recovered with STSG, surgical debridement, and MDT. This case was reported in accordance with the SCARE 2020 guidelines [11].

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Fig. 1. Diabetic foot ulcer before combination therapy.

Table 1
The patient's laboratory data.

Lab. value	Result
Hemoglobin A1C	8 %
Blood sugar	510 mg/dl
High-density lipoprotein	39 mg/dl
Low-density lipoprotein	78 mg/dl
Cholesterol	196 mg/dl
Triglycerides	80 mg/dl
Blood urea	18.5 mg/dl
Blood creatinine	0.83 mg/dl
Hemoglobin	10.1 g/dl
Hematocrit	32 %

2. Case presentation

This patient is a 56-year-old woman who has had type 2 diabetes for 11 years and a left-sided DFU for two years. She comes from a household of middle socioeconomic status. She has also been sewing in a workshop for 25 years. To date, she has been hospitalized six times for standard treatment of DFU, including normal saline wound dressing and antibiotic therapy. She has a history of poor glycemic control and hypothyroidism; diabetes mellitus and hypertension run in the patient's family.

To control her blood glucose, she had undergone pharmacological treatment with metformin 500 mg three times a day (TDS). She denied any history of drug or alcohol abuse, although she smoked a pack of cigarettes daily. Neurologic examinations revealed no pathologic findings. Although the patient had been hospitalized several times for treatment of DFU, she had not recovered (Fig. 1).

The patient was admitted to Imam Reza Hospital in Urmia on July 12, 2022, complaining mainly of ulceration of the left foot. In addition, the patient was found to have an antibiotic-resistant DFU on the left foot, which was completely gangrenous, and a superficial ulcer on and under the left foot (Fig. 1). During history taking and physical examination, the patient was found to have antibiotic-resistant DFU. The patient's culture antibiogram indicated the microorganisms *Staphylococcus aureus* and *Pseudomonas aeruginosa* were responsible for the infection. Some of the patient's laboratory data on admission were as follows (Table 1):

During hospitalization, the patient initially received amp ciprofloxacin 400 mg, amp clindamycin 900 mg, amp meropenem 1 g, and amp vancomycin 1 g intravenously. The osteomyelitis in the patient's right leg was evaluated by color Doppler imaging (CDI) and magnetic resonance imaging (MRI). Unfortunately, the patient did not recover from the DFU using standard methods, although she was treated with antibiotics and a normal saline dressing. The patient was asked to undergo an orthopedic consultation, based on which she was considered for left foot amputation. The patient refused to consent to amputation and was subsequently referred to our wound care service.

The severity of the diabetic foot infection was such that the patient was experiencing sepsis symptoms (fever, chills, tachycardia, and hypotension). The patient's vital signs on admission were as follows: Temperature: 38.8 °C, respiratory rate: 23 bpm, pulse rate: 113 bpm, blood pressure: 150/85 mm Hg.

Since necrotic and infectious tissue was present, surgical debridement of the DFU was first performed by a surgeon (Fig. 2). Then, larvae of *L. sericata* were dissected under sterile conditions, and it was subjected to MDT. The maggots were obtained from the Medical Entomology Laboratory of the School of Public Health, College of Medical Sciences, Tehran, Iran. These larvae eat dead tissue and bacteria at the wound site and release antimicrobial enzymes that promote wound healing. MDT was performed in four steps: Wound preparation, application of larvae to the wound, hydrocolloid dressing, and removal of larvae after 48 h (Fig. 3). To prepare the wound, a surgical drape was placed on the patient's wound and the wound was irrigated with physiological saline. At each stage of the procedure, the patient was asked every 20 min whether she tolerated the MDT and continued with the procedure. If the answer was “yes”, the procedure was continued; if the answer was “no”, the procedure was discontinued. A total of ten sessions of MDT were performed (one session every 48 h). After the start of MDT, the odor of the infection had completely disappeared. The procedures were performed by a nurse (first author) who was trained and certified in this field. After completion of MDT and preparation of the wound bed (Fig. 3), a split-thickness skin graft was performed by a surgeon (Fig. 4). The patient was discharged from our department with a good and stable general condition.

3. Discussion

DFUs are a common complication of DM, causing severe physical and even psychological disability for those affected [3]. DFUs can develop for a variety of reasons. One possibility of wound development may be related to pain receptor dysfunction, which occurs as a secondary complication of DFU in the form of peripheral neuropathy [2]. Inadequate vascular perfusion in diabetic patients is another likely risk for the

Fig. 2. Diabetic foot ulcer after surgical debridement.

Fig. 3. Diabetic foot ulcer after MDT.

development of DFU, as this chronic condition is the main cause due to high blood glucose levels [1]. In addition, excessive blood glucose has a significant impact on the human defense system, as it is unable to adequately and efficiently fight invasive microbes, and the patient eventually develops DFU [12].

DFU greatly affects the quality of life and is responsible for a large number of deaths and illnesses. In addition, DFU can lead to serious complications such as infections, sepsis, and amputations [5]. It has been shown that monotherapy leads to a very slow progression of the wound healing process, whereas a mix of different methods to treat DFU leads to much better outcomes, whether in terms of quality or duration of recovery [10].

In this case report, we used three different methods for the patient to maximize the effectiveness of the treatment process. In other words, we used maggots to eradicate the necrotic tissue, followed by sharp debridement, and finally a split-thickness skin graft on the wound, achieving a very comfortable result.

Consistent with our study results, Parizad et al. demonstrated that the combined use of MDT, surgical debridement, silver dressing, and negative pressure wound therapy (NPWT) is very effective in treating refractory DFU [10]. The graft portion of our procedure was significantly different from the study by Parizad et al. Therefore, we felt that this might be the likely reason for the better results in the comparison. Consistent with our study, Babak Choobianzali et al. performed a wound care study of a patient with DFU in which they used maggots to heal the ulcer. The results of this study were in agreement with our research but differed from our transcendence in the timing of treatment [5]. In addition, Hajimohammadi et al. demonstrated in a case study that surgical debridement and maggot therapy are effective procedures for the treatment of DFUs, most likely preventing impending amputation in diabetic patients [13].

There are numerous studies in this field that have suggested approaches for the treatment of DFUs, but in this case report study, we witnessed a very effective mixture of treatments that we highly recommend for the recovery of DFUs.

Skin grafting is a surgical procedure that helps to replace lost or damaged skin, improve its appearance, and restore its function. The type of skin graft, the length of the procedure, and the healing time depend on the condition and the size of the wound. Most skin grafts are successful. Sometimes the body does not accept the graft, and a person may need a second graft.

4. Conclusion

Infectious DFU causes irreparable damage to the patient's performance and quality of life. This case study demonstrated that the combined use of STSG, surgical debridement, and MDT is a safe and effective approach to improve healing of DFUs and prevent foot amputations.

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.

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Ethical approval is waived at our institution.

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Fig. 4. Diabetic foot ulcer after STSG.

Research registration number

1. Name of the registry: not applicable
2. Unique identifying number or registration ID: not applicable
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): not applicable.

CRediT authorship contribution statement

Rasoul Goli and Kamal Rahimi: Study concept, data collection, writing the paper and making the revision of the manuscript following the reviewer's instructions. Leila Hosseinpour and Sahar Majidi Balaneji: Study concept, reviewing and validating the manuscript's credibility. Navid Faraji and Behnam Babamiri: reviewing and validating the manuscript's credibility.

Conflict of interest

N/A.

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