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Case Report

Diabetic foot salvage: breaking paradigms through a case report

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Abstract

Diabetic foot (DF) is one of the most frequent and disabling complications of diabetes mellitus 2 (DM2). This study presents the case of a 66-year-old female patient with DM2 and DF complicated by extensive infected necrosis involving more than 50% of the foot. She was not a candidate for revascularization and, due to the poorly controlled septic focus and the extent of necrosis, infracondylar amputation was indicated. However, as the patient refused to undergo amputation, the case was re-evaluated at another health institution and a multidisciplinary therapeutic plan for DF salvage was proposed. The protocol included antibiotic therapy, surgical debridement, periodic outpatient dressing, and negative pressure wound therapy (NPWT). After ten months of treatment, the limb showed almost complete healing, and amputation was not necessary. Management of complicated DF is currently one of the greatest clinical-surgical challenges, requiring a highly trained multidisciplinary team to propose an optimal limb salvage program.

Level of Evidence V; Case Report; Expert Opinion.

Keywords: Diabetic foot; Necrosis; Amputation; Wound healing; Negative pressure wound therapy.

Introduction

Diabetic foot (DF) is one of the most frequent and debilitating complications of diabetes mellitus 2 (DM2). It is estimated that about 15–34% of patients suffer from complicated DF, and 20% of them end up undergoing minor and major amputations[1]. The condition is often associated with skin disorders, necrosis, and sepsis, and can extend to deeper structures, such as musculoskeletal structures, causing osteomyelitis (26.4%) and fasciitis (11.8%)[2]. The main etiology of DF is ischemic (28%), neuropathic (21%), and mixed (51%), and it can be triggered by various extrinsic factors, such as trauma (75.9%) and burns (4%)[2,3]. In recent years, the rate of amputations caused by DF has increased to 1.5–3 per 1,000 patients with DM2, and these amputations are associated with a poor 5-year patient survival due to disability, prolonged immobilization, long hospital stays, and infections[3].

The DF salvage plan includes a multidisciplinary assessment by clinical specialties, such as endocrinology, internal medicine, physical medicine, and rehabilitation, and surgical specialties, such as traumatology and orthopedics and vascular and plastic surgery. Management of the internal environment and antibiotic treatment should always accompany surgical therapy, the latter consisting of surgical and chemical debridement of necrotic tissue, negative pressure wound therapy (NPWT, silver sponges), ambulatory wound healing (ionic silver hydrogels), and exudate management[1,3]. The whole process involved in the limb salvage protocol requires strict monitoring and control of risk factors, which allow the main conditions associated with the limb to be controlled.

Case description

The present case report was approved by the Research Ethics Committee of the institution.

Study performed at the Delgado Auna Clinic, Lima, Peru.

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A 66-year-old woman with a long history of uncontrolled DM2 presented with a DF complicated by limited plantar necrosis (3x5cm) with a disease period of three months prior to hospital admission. The lesion was not treated or cured due to the patient's lack of knowledge; it gradually increased in extent until it involved more than 50% of the foot, and pain, fever, and significant functional limitation were added. Patient was admitted to the hospital emergency department, where she was classified as having complicated DF with a WIfI score IV (Wound, 3; Ischemia, 2; Foot Infection, 3), with a high risk of amputation.

Physical examination revealed a febrile condition (39.2°C), tachycardia, and arterial normotension. Extensive wet necrosis (17x10cm) was observed involving the plantar region, forefoot, ankle, and, partially, the right pretibial region, with exposure of osteomuscular tissue (calcaneus) associated with local inflammatory signs, abundant seropurulent discharge, and bad smell (Figure 1). In addition, femoral and popliteal arterial pulse, posterior tibial and pedal were identified. Laboratory tests showed mild anemia (10.3g/dL), leukocytosis with left shift (18x10^3L), creatinine (0.96mg/dL), urea (48mg/dL), glycaemia (185mg/dL), hemoglobin A1C (12%), high-density lipoprotein (HDL) (40mg/dL), low-density lipoprotein (LDL) (180mg/dL), and triglycerides (200mg/dL). Arterial Doppler ultrasound showed a significant, moderate posterior tibial and pedal artery stenosis (50%), and radiography of the affected area showed no indirect signs of osteomyelitis.

The initial treatment plan proposed was antibiotic therapy, evaluation by vascular surgery, and traumatology. Patient was not a candidate for open or endovascular revascularization and, due to uncontrolled sepsis and the large extent of necrosis, left infracondylar amputation was considered. Patient refused this treatment and left the hospital by voluntary withdrawal, seeking another health institution.

The second assessment was multidisciplinary, and the DF salvage protocol was activated, which included antibiotic therapy according to the wound culture (vancomycin and meropenem for *Staphylococcus aureus* and gram-negative bacteria), management of the internal environment (insulin therapy), possibility of subsequent revascularization due to the moderate degree of arterial insufficiency, surgical debridement, and ambulatory healing of lesions for nine months. These last two interventions were aimed at removing necrotic material from the wound (subcutaneous tissue, fat, and muscle), allowing adequate granulation and regeneration of the DF. The microbiological and anatomopathological study of the lesion confirmed the presence of gram-positive and negative bacteria, with abundant polymorphonuclear cellularity in all stages.

Figure 1. A-B) Salvage of complicated DF. C-D) DF with extensive infected necrosis of the right foot. E-F) DF after initial surgical debridement. Use of NPWT with silver sponges. G-H) DF with granulation tissue and ambulatory healing. I-J) DF after 8–9 months with almost complete tissue recovery.

After surgical cleanings, the use of topical negative pressure (TPN) with silver sponges (intermittent pressure of 125mmHg/three weekly changes for three weeks) and daily ambulatory cures with ionic silver hydrogels were proposed for the following nine months. During ambulatory controls, a satisfactory evolution of the wound was observed, with total removal of the necrotic tissue and presence of abundant granulation tissue over the entire affected surface.

Among outpatient indications, oral antibiotic therapy was indicated to treat the soft tissue infection (ciprofloxacin and clindamycin/three weeks according to the previously described cultures for sensitive gram-positive and negative bacteria), insulin therapy, analgesia, and the use of physical aids (crutches) to support walking, besides avoiding bearing weight on the affected limb and providing timely pressure relief for optimal healing of the DF. Finally, ten months after salvage intervention, the limb regained full integrity and amputation was avoided (Figure 2). Currently, the patient continues with her outpatient controls by outpatient consultation and under constant functional rehabilitation of the limb. Patient is currently able to walk 150–300 meters in approximately 10-15 minutes.

Figure 2. Final result. A-D) Total healing of complicated DF after nine months of DF salvage protocol.

Discussion

Skin lesions caused by DF can be complicated by infection and sepsis and even require amputation of the affected limb, negatively affecting the diabetic patient's quality of life. According to the multicenter study published by Yovera-Aldana et al.[4], in Peru, the estimated prevalence of the main complications of DF was 60% for neuropathy and ischemia, 40% of lesions involved muscle and tendon involvement, 5% of lesions presented bone and joint involvement, and approximately 8.6% of DF cases led to the amputation of the affected limb. Standard treatments for DF include surgical debridement of the wound, moist wound healing by dressing and saline irrigation, offloading the affected limb, revascularization techniques, infection treatment, and strict glycemic control[1,3]. However, using these treatment methods, only 30% of DF patients heal within the first 20 weeks, which is mainly conditioned by the resistance profile of the related pathogenic microorganisms, irreversibility of vascular damage, and healing technique used[2-4].

One of the most widespread healing techniques in recent decades is NPWT, whose main mechanism of action works at the tissue level through "macrodeformation", which consists of contracting the edges of the lesion producing a decrease in the overall diameter, and "microdeformation", stimulating cell proliferation, migration and differentiation, generation of granulation tissue, angiogenesis, and epithelialization[1,3]. Recently, in a systematic review, Dehghan et al.[3] and Yovera-Aldana et al.[4] described that NPWT efficacy is associated with increased granulation tissue formation, a low incidence of amputation, and reduction of wound area and depth. Similarly, Lavery et al.[5] compared the efficacy of NPWT+saline irrigation with that of NPWT+polyhexanide-betaine 0.1% irrigation in patients with infected DF, finding that the latter did not demonstrate significant improvements in wound healing relative to saline. In our case, NPWT was applied for four weeks and, then, we proceeded to ambulatory healing for approximately ten months-these periods have been the subject of multiple studies, such as the one described by Węgrzynowski et al.[6], who evaluated NPWT for "extended time" (±4 weeks) in patients with DF and observed a significant decrease of 92% in the risk of amputation compared to that seen in the short-time NPWT group. The abovementioned study also highlights the importance of microbial control in DF lesions, describing the lack of any benefit from the use of NPWT in infected ischemic lesions or active sepsis. Other investigations have attempted to compare NPWT with conventional saline irrigation healing; however, the former demonstrated superiority due to a significant affected area reduction, better granulation rates, and even complete regeneration (98.7%) of the affected area compared to saline alone, with a complete healing rate of 26% at 3-month follow-up[7]. On the other hand, an analysis on NPWT considering the type of sponge used, Malmsjö and Ingemansson[8], determined the efficacy of black and green polyurethane sponges, which, due to their pore size, have shown optimal regeneration of granulation tissue compared to that produced when only gauze is used on the lesion.

DF complicated by necrosis and infection is one of the spectra seen in late vascular manifestations of DM and is by now one of the leading causes of limb loss in the world. The severity of soft tissue and bone involvement adds to the systemic consequences of infection, generating a proinflammatory and immunosuppressive state that conditions a poor prognosis for survival in more than 50% of cases[1,3]. The role of antibiotic therapy directed to the micro-organism identified by culture is one of the main therapeutic weapons available and, together with surgical debridement, has demonstrated cure rates of up to 72%. However, it is necessary to add further curative strategies such as NPWT, the use of sponges, and, if necessary, after vascular assessment, the coverage of extensive lesions with skin grafts[5,8].

In our case, patient had a history of poor and inadequate glycemic control for approximately 30 years, conditioning the development of late complications of DM2, such as DF. This was initially managed in two stages, in-hospital and out-of-hospital-the first one basically for surgical cleaning, stabilization of the internal environment, intravenous antibiotic therapy, and use of NPWT, while the second phase was exclusively focused on daily outpatient dressings and maintenance of DM2 management measures. This whole process has been almost systematically established as a part of the DF salvage protocol and is now a therapeutic model that has been progressively implemented in major healthcare institutions nationwide[5,6,9].

Conclusion

Currently, despite the wide dissemination of different DF management techniques, there is still limited information on studies with combined therapy for the management of this condition, which is why, according to the results obtained, we highlight the importance of implementing the DF salvage protocol to establish continuous and long-term multidisciplinary management of this type of lesions. Likewise, it is essential to educate patients with DM2 at risk of DF, their families, and caregivers to prevent injuries associated with the disease and care for them, avoiding their progression and promoting early healing with low rates of limb loss.

Authors' contributions: Each author contributed individually and significantly to the development of this article: IC *(https://orcid.org/0000-0002-4274-8370) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, statistical analysis, bibliographic review, survey of the medical records, formatting of the article, clinical examination and approved the final version; JQ *(https://orcid.org/0000-0002-4014-4952) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, statistical analysis, bibliographic review, survey of the medical records, formatting of the article, clinical examination and approved the final version; HM *(https://orcid.org/0000-0001-8405-9373) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, statistical analysis, bibliographic review, survey of the medical records, formatting of the article, clinical examination and approved the final version; MVS *(https://orcid.org/0000-0003-4504-4050) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, statistical analysis, bibliographic review, survey of the medical records, formatting of the article, clinical examination and approved the final version; WSC *(https://orcid.org/0000-0002-5380-7372) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, statistical analysis, bibliographic review, survey of the medical records, formatting of the article, clinical examination and approved the final version. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

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