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วารสารสมาคมศัลยแพทย์ทั่วไปแห่งประเทศไทยในพระบรมราชูปถัมภ์
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Case Report

Infected Diabetes Foot Ulcer to Bony Structure Treating with Polyhexanide and Covering with Skin Substitute: A Case Report

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ABSTRACT

Background: Diabetic foot ulcers are a common and challenging complication in patients with diabetes mellitus, often complicated by infection and poor wound healing. Effective management requires adequate infection control, wound bed preparation, and optimized healing environment.

Case Presentation: A 67-year-old female with newly diagnosed type 2 diabetes mellitus presented with a non-healing plantar foot ulcer persisting for three weeks following hot water immersion. The wound was complicated by systemic infection and exposed plantar fascia. Surgical debridement was performed to remove necrotic tissue and reduce bacterial load. Wound cleansing with polyhexamethylene biguanide (PHMB) solution was employed to prevent biofilm formation. Periwound hyperkeratosis was trimmed, and dressings including polyurethane foam Dressil and polyurethane foam Heel were applied for moisture management and pressure offloading. Vascular assessments (ABI, TBI, TCOM) confirmed adequate perfusion. A biological skin substitute was subsequently used to promote tissue regeneration and wound closure.

Results: Infection was effectively controlled, and granulation tissue formation was observed over the previously exposed fascia. Minimal biofilm was managed with PHMB irrigation. The wound depth decreased rapidly after application of the skin substitute, with accelerated healing noted without need for complex reconstructive surgery.

Conclusion: Comprehensive wound care–including debridement, infection control, and the use of PHMB solution for biofilm management–plays a key role in treating complicated diabetic foot ulcers. PHMB may accelerate healing by reducing microbial burden, while advanced techniques help improve outcomes and limit invasive procedures.

Keywords: Diabetic foot ulcer, Wound healing, Wound cleansing, Biofilm, Skin substitute

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Introduction

Chronic wounds, particularly in patients with diabetes mellitus, present a significant challenge in clinical practice due to impaired wound healing and increased risk of infection.[1] Diabetic foot ulcers (DFUs) are among the most serious complications, often leading to prolonged hospitalization, limb-threatening infections, and even amputation if not properly managed.[2,3] One of the key factors contributing to poor healing outcomes is the presence of biofilms and persistent infection, which can create a hostile wound environment and impede tissue regeneration.[4]

Effective wound management requires a comprehensive approach that includes infection control, adequate debridement, moisture balance, and preservation of the periwound skin. Advanced wound care products and adjunctive therapies, such as antimicrobial solutions and biological skin substitutes, have emerged as promising tools to enhance healing, especially in complex or hard-to-heal wounds.

This case report presents the management of a diabetic foot ulcer, focusing on infection control through surgical debridement and the use of a solution containing Polyhexanide and Betaine for biofilm management.[5,6] The case also illustrates the role of polyurethane foam dressings for exudate control and skin protection as well as the application of biological skin substitute, a novel fish-skin derived skin substitute, to promote granulation and wound closure.[7,8] This case highlights the importance of basic wound care principles in conjunction with advanced materials to achieve optimal outcomes without the need for complex surgical reconstruction.

A Case Report

A 67-year-old female with newly diagnosed type 2 diabetes mellitus presented with a non-healing ulcer located on the right plantar surface, persisting for three weeks. The ulcer developed following immersion of her foot in hot water, a common but preventable mechanism of injury in diabetic patients with peripheral neuropathy. Prior to hospital admission, she demonstrated clinical signs of systemic infection, including fever and elevated inflammatory markers, consistent with sepsis.

On examination, the wound was characterized by necrotic tissue and purulent discharge, with localized signs of infection. Surgical debridement was promptly performed to remove devitalized tissue and reduce the microbial burden. Intra-operatively, the plantar fascia was exposed and required partial debridement. Although the calcaneus bone was palpable, there was no evidence of osteolytic changes upon clinical assessment. A significant volume of pus was evacuated, and the wound bed was adequately prepared; however, a region of exposed bone remained post-debridement.

To minimize bacterial load and prevent the recurrence of biofilm, the wound was irrigated with a wound cleanser containing Betaine (a surfactant) and Polyhexanide (a broad-spectrum antimicrobial agent). This solution was selected due to its efficacy in biofilm disruption, a critical factor in the management of chronic and infected wounds.

Periwound management was also emphasized. Hyperkeratosis at the wound margins was carefully excised to facilitate epithelial migration. The wound was subsequently dressed with a hydrocellular foam dressing designed for exudate absorption and maintenance of a moist wound environment. To offload pressure from the weight-bearing heel and prevent further tissue breakdown, polyurethane foam was applied.

To evaluate the vascular status and ensure the wound was adequately perfused–a prerequisite for healing and potential use of tissue substitutes–non-invasive vascular assessments were conducted. These included the Ankle-Brachial Index (ABI), Toe-Brachial Index (TBI), and Transcutaneous Oxygen Measurement (TCOM). All parameters indicated satisfactory peripheral circulation, supporting the feasibility of advanced wound closure strategies.

In the later phase of treatment, a biological skin substitute was used to cover the wound and promote tissue regeneration. The selected material aimed to stimulate cellular ingrowth, angiogenesis, and re-epithelialization over the wound.

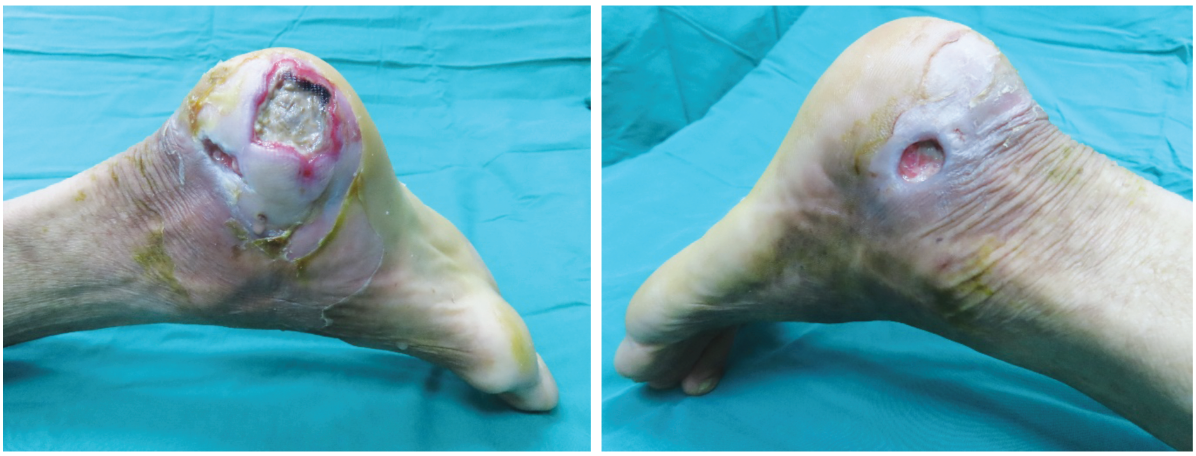

Figure 1 Initial wound medial and lateral side.

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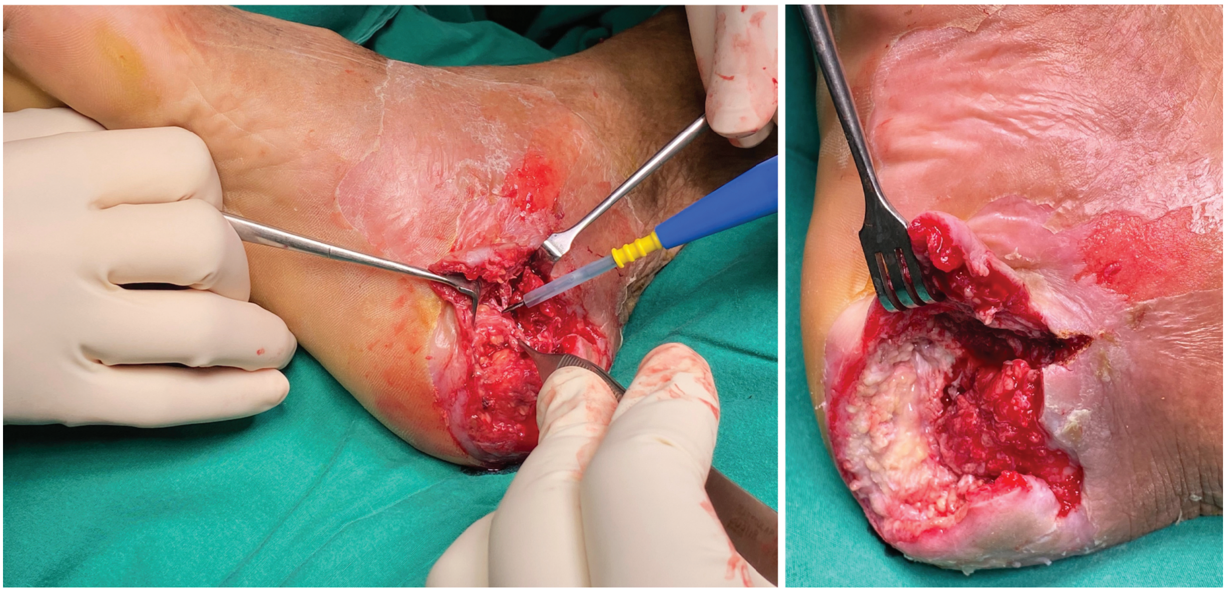

Figure 2 Wound Debridement

Figure 3 Before biological skin substitute placement

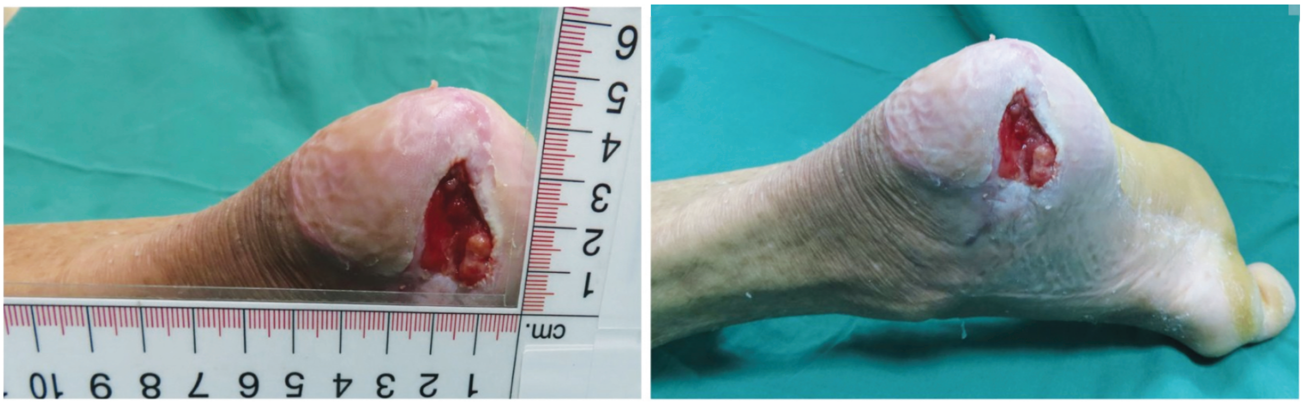

Figure 4 After 1st time biological skin substitute placement

Figure 5 biological skin substitute placement

Discussions

The vascular assessment, including ankle-brachial index (ABI), toe-brachial index (TBI), and transcutaneous oxygen measurement (TCOM), demonstrated adequate perfusion with no evidence of vascular impairment, thereby confirming the patient's candidacy for advanced wound therapies. Glycemic control was achieved and maintained throughout the treatment period, which is a critical factor in wound healing, especially in diabetic patients.[9]

Initial infection was effectively managed through timely surgical debridement and intravenous antibiotic therapy. A substantial amount of exudate was observed in the early treatment phase, which was successfully absorbed using polyurethane foam dressing. As the infection subsided and inflammation decreased, the volume of exudate progressively reduced. Robust granulation tissue formed over the exposed fascia and bone within weeks, indicating effective wound bed preparation and host response.

While minimal biofilm formation was observed during follow-up wound care, it was completely removed using a wound irrigation solution containing Betaine and Polyhexanide. This product played a critical adjunctive role

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in preventing biofilm regrowth and maintaining a clean wound environment. Polyhexanide, in particular, is supported by multiple studies for its broad-spectrum antimicrobial properties and effectiveness in disrupting established biofilms.[10] Since microbial colonization and biofilm formation can impede oxygen diffusion and block therapeutic contact with wound bed cells, their elimination is essential to accelerate wound healing. Moreover, polyhexamethylene biguanide (PHMB) solution may help decreasing biofilms and increasing rate of wound healing. Patients prefer to do the bedside wound dressing without pain rather than going to the operating room.

Periwound skin management was another key element contributing to healing success. The presence of hyperkeratosis, rolled wound edges, or maceration can inhibit epithelial migration, thus delaying wound closure. In this case, trimming the hyperkeratotic edges and using silver alginate impregnated polyurethane foam dressings helped protect the periwound skin from excess moisture and mechanical friction. This environment supported effective re-epithelialization and reduced the risk of wound recurrence.

In the final phase of care, a biological skin substitute was applied over the well-vascularized granulation tissue. This biological skin substitute , derived from fish skin, mimics the structure of human dermis and serves as a scaffold for cellular ingrowth and tissue regeneration.[8,11] Its natural extracellular matrix composition supports angiogenesis and re-epithelialization, making it particularly suitable for hard-to-heal wounds. In this case, the application of biological skin substitute significantly accelerated the healing trajectory, with a rapid reduction in wound depth and enhanced epithelialization observed following its use.

Although a variety of advanced surgical interventions are available for complicated chronic wounds, this case illustrates that meticulous wound care–including infection control, moisture balance, and periwound protection–can lead to successful healing outcomes without the need for complex reconstructive procedures.

Conclusions

This case highlights the importance of comprehensive wound care—including surgical debridement, infection control, periwound protection, vascular assessment, advance wound dressing and biological skin substitutes which play an important role of complicated DM foot ulcer. The use of PHMB, a wound irrigation solution, proved effective in reducing microbial burden and disrupting biofilm and may accelerate wound healing. The integration of advanced wound care technique can enhance healing outcomes and reduce the need for invasive interventions.

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