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Case Report

Management of Complex Third-Degree Burn with Multi-Drug-Resistant Infection Using Instillation Negative Pressure Wound Therapy and PHMB Irrigation Solution: A Case Report

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ABSTRACT

Severe burn injuries complicated by multi-drug-resistant infections and systemic organ dysfunction pose significant treatment challenges. Advanced wound care techniques like negative pressure wound therapy with instillation (NPWTi) have shown promise in enhancing wound healing and controlling local infections. Polyhexanide-based irrigation solution offers antimicrobial effects and biofilm disruption, improving wound bed preparation. We report a case of a 65-year-old male with a third-degree burn involving 15% of the total body surface area on his right leg, caused by prolonged contact with hot coals during sleep. Despite multiple debridements at the initial hospital, the wound deteriorated, exhibiting thick slough, purulent discharge, and tibial bone exposure. Upon referral, the patient showed signs of sepsis, acute kidney injury, and acute lung injury. Broad-spectrum intravenous antibiotics were initiated. Tissue cultures identified Carbapenem-Resistant Enterobacteriaceae (Klebsiella pneumoniae) and multi-drug-resistant Pseudomonas aeruginosa. Local management included surgical and chemical debridement followed by NPWTi with Polyhexamethylene biguanide hydrochloride irrigation. This

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treatment promoted rapid granulation tissue formation and significantly reduced bacterial load, confirmed by follow-up cultures. However, systemic complications arose, including secondary fungal infection and worsening renal function. After multidisciplinary evaluation, an above-knee amputation was performed as a life-saving intervention. This case underscores the critical importance of early and aggressive infection control using NPWTi with polyhexanide in managing complex burn wounds, while systemic factors remain key determinants of patient outcomes.

Keywords: Negative pressure wound therapy, Instillation, Polyhexamethylene biguanide hydrochloride, Infected wound, Wound care

Introduction

Severe wound management, particularly in burn patients with complex or infected wounds, presents a significant challenge in clinical practice.[1] The effective wound care strategies can minimize complications, accelerate healing, and control costs. Infection is a major complication in wound management, often prolonging hospitalization, increasing the need for intensive care, and escalating treatment expenses.[2,3] Even though there is no standard guideline treatment of burn wound infection, early and effective infection control is therefore essential to improve clinical outcomes and reduce the economic impact on healthcare systems. The challenge of burn wound care is burn wound size and depth, as well as the fragility of patients which trends to easily get multi-drug-resistant infection.[4,5] Advanced wound care techniques, including negative pressure wound therapy (NPWT) with instillation, have demonstrated efficacy in promoting wound healing, controlling infection, and reducing the frequency of dressing changes.[6,7]

Polyhexamethylene biguanide hydrochloride (PHMB) irrigation solution is an advanced wound irrigation solution that provides multiple benefits in wound management. It effectively reduces bacterial load, disrupts biofilms, and prevents infection, creating an optimal environment for wound healing.[8] It is well-tolerated, safe for long-term use, and suitable for various wound types, including chronic wounds and burns.

This case report demonstrates the clinical application and effectiveness of instillation vacuum-assisted wound therapy combined with PHMB irrigation solution in controlling severe bacterial infection, promoting granulation tissue formation, and improving wound management outcomes in a patient with complex burn wounds complicated by systemic infection and multi-organ dysfunction.

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A Case Report

A 65-year-old male was referred to our institute with a third-degree burn covering approximately 15% of the total body surface area on his right leg. The injury occurred when the patient accidentally came into prolonged contact with hot coals while sleeping, resulting in deep tissue destruction. Initially, he was treated at a local hospital where multiple surgical debridements were performed over a two-week period. Despite these interventions, the wound condition progressively worsened.

After two weeks of treatment, he was referred to our institute with a thick slough, turbid discharge, and foul-smelling burn wound on his leg. The tibia bone was barely exposed. The patient's general condition was poor upon arrival. Upon arrival at our institute, the patient appeared acutely ill and was in moderate distress. His vital signs were as follows: body temperature 38.9°C, blood pressure 90/60 mmHg, pulse rate 112 beats per minute, respiratory rate 24 breaths per minute, and oxygen saturation 92% on room air. He was febrile, tachycardic, and hypotensive, consistent with signs of sepsis. Laboratory investigations showed elevated white blood cell count, increased serum creatinine, and abnormal arterial blood gases, all of which pointed to multi-organ involvement. The primary concern in this case was the management of severe infection, both local and systemic. Intensive care monitoring was implemented to closely observe the progression of organ dysfunction, particularly the acute kidney injury and acute lung injury, which required supportive management.

Wound management

Local examination of the right leg revealed a large third-degree burn wound extending from the mid-thigh to the lower leg, covering approximately 15% of the total body surface area. The wound bed was covered with thick yellowish slough and emitted a foul odor as shown in Figure 1. There was copious turbid discharge, and the anterior aspect of the tibial bone was partially exposed. Local wound management focused on controlling the heavy bioburden and removing necrotic tissue. Surgical debridement was performed to excise devitalized tissue and reduce the source of infection. Chemical debridement using antiseptic solutions complemented the surgical approach, ensuring a cleaner wound bed. Initially, the wound's copious exudate and contamination were managed with conventional moist dressings. However, once the systemic infection was stabilized and local signs of infection were brought under control, advanced wound management was initiated.

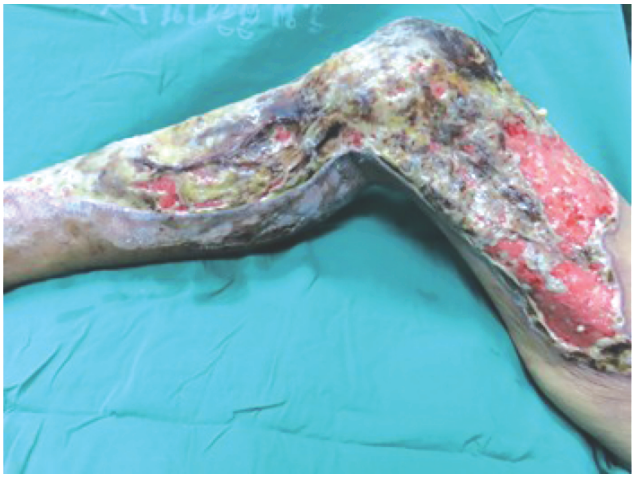

Figure 1 The wound bed was covered with thick yellowish slough.

The dressing was switched to an instillation negative pressure wound therapy (NPWTi) system using PHMB irrigation solution. This technique provided continuous wound cleansing while maintaining negative pressure, allowing for a controlled wound environment that promoted granulation tissue formation. Importantly, it also reduced the need for frequent dressing changes, minimizing patient discomfort and nursing workload.

Due to the exposed tibial bone, bone drilling was performed to stimulate vascular ingrowth and granulation tissue formation over the bone surface, reducing the risk of osteomyelitis and preparing the wound for potential closure procedures. In parallel, comprehensive nutritional support was provided, recognizing the critical role of adequate nutrition in wound healing and systemic recovery, especially in elderly patients with comorbidities and prolonged catabolic stress.

After receiving intensive treatment at Siriraj Hospital, his organ function stabilized, and no further deterioration was observed during hospitalization. The systemic infection was managed with intravenous broad-spectrum antibiotics including Meropenem, Vancomycin, and Colistin. Early tissue and wound cultures identified Carbapenem-Resistant Enterobacteriaceae (Klebsiella pneumoniae) and multi-drug-resistant Pseudomonas aeruginosa, necessitating the use of targeted antimicrobial therapy based on sensitivity results.

Local wound management began with meticulous surgical debridement, effectively reducing the necrotic tissue load and controlling the local infection. Following debridement, the wound slough significantly decreased. The use of instillation vacuum-assisted closure (VAC) with PHMB irrigation solution was initiated within the first week, which provided continuous wound cleansing and antimicrobial irrigation while applying negative pressure. This method resulted in rapid formation of high-quality granulation tissue without further signs of infection as shown in Figure 2. The success of this approach highlights the synergistic benefits of negative pressure

therapy combined with polyhexanide-containing irrigation solution, consistent with findings from previous studies demonstrating its efficacy in reducing bacterial load and promoting wound healing.

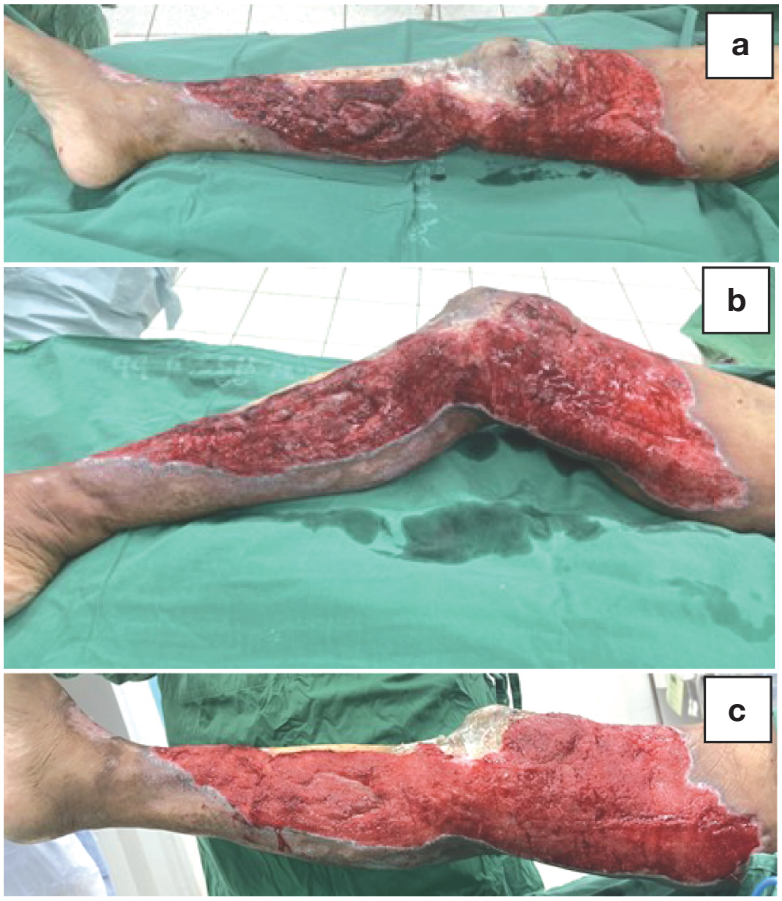

Figure 2 Wound bed after instillation negative pressure wound therapy (NPWTi) system using PHMB irrigation solution at 2 weeks (a), 3 weeks (b) and 4 weeks (c).

Tissue specimens collected during follow-up debridement showed a marked decrease in bacterial colony counts, confirming effective infection control at the wound site. However, despite local wound improvement, the patient's overall condition remained compromised due to the cumulative effects of multiple organ dysfunctions. His prolonged catabolic state and systemic inflammation led to immunosuppression, predisposing him to secondary opportunistic infections. Subsequently, a fungal infection developed at the wound site.

Although antifungal therapy was initiated, the patient's deteriorating renal function, indicated by rising creatinine levels, complicated the choice and administration of antifungal medications. After comprehensive discussions with the multidisciplinary team and the patient's family, weighing the risks, benefits, and expected quality of life, a decision was made to proceed with above-knee amputation (AKA) as a life-saving intervention after 40 days of treatment.

Discussion

Infection control is a critical component of burn wound management, particularly in cases involving extensive tissue loss and exposure of underlying structures such as bone. The subsequent use of instillation negative pressure wound therapy (NPWTi) with polyhexanide-containing PHMB irrigation solution facilitated the rapid formation of high-quality granulation tissue without further signs of infection. This approach aligns with previous studies demonstrating that NPWTi can effectively reduce bacterial colonization while promoting granulation, thereby enhancing wound bed preparation and reducing the need for frequent dressing changes.[9-11] Microbiological analysis in this case confirmed a significant decrease in bacterial colony counts after treatment. However, despite successful local infection control, the patient's overall recovery was limited by the systemic consequences of prolonged multi-organ dysfunction, including acute kidney injury and acute lung injury, which compromised immune function.

Conclusion

The complexity of managing severe burn wounds complicated by multi-drug-resistant infections and organ dysfunction is a critical challenge in burn care management. Early and aggressive local infection control using instillation negative pressure wound therapy with polyhexanide irrigation proved effective in reducing bacterial load and promoting granulation tissue formation. Comprehensive multidisciplinary care, early intervention, and timely decision-making are crucial to optimize survival and quality of life in high-risk burn patients.

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