

# Diabetic feet with plantar thermal burn wounds – a patient optimisation and preservative care approach

**Keywords** diabetes, thermal burns, infection, neuropathy, preservative care.

**For referencing** Smart H, Cronje FJ. Diabetic feet with plantar thermal burn wounds – a patient optimisation and preservative care approach. WCET® Journal 2024;44(4):24-27.

**DOI** <https://doi.org/10.33235/wcet.44.4.24-27>

## INTRODUCTION

All wounds tell a story. This one began on the western Arabian Peninsula and involved a patient who had just returned from attending the 2024 Hajj pilgrimage in Mecca. This time of year (called 'Eid') clocked record-breaking temperatures, with extensive news coverage on the subsequent impact on the morbidity and mortality of the pilgrims.<sup>1</sup>

While taking part, barefoot, in the midday prayers, our 40-year-old patient – with a history of >10 years of non-insulin-dependent diabetes – sustained full-thickness burns on the plantar surface of his right foot and partial-deep thickness burns to the other.<sup>2</sup> The neuropathic insensitivity of his feet offered no protective warning of the thermal insult.<sup>3</sup> A day later, his wife, who had accompanied him, noticed sacks with fluid on the bottom of his feet – still with no pain. He completed the full Hajj as planned and then returned to his residence. The blisters were broken to allow him to wear shoes for his return.

## PATIENT ASSESSMENT

At home, the patient developed a severe wound infection in his right foot within two days, prompting him to seek medical attention at a primary care facility. Initial treatment included systemic oral antibiotics and topical ointment applied to both soles of his feet. He was promptly referred to our Advanced Wound Care and Baromedicine Department and was evaluated the following day. By this time, his burn wounds were four days old, and he was experiencing persistent pain in his right foot, rated at 4-5 on a Visual Analogue Scale.

Upon initial assessment, the right foot presented with significant clinical signs of deep wound infection. A 6°F

temperature differential was noted between the right foot and both the left foot and right upper leg. The feet also exhibited circumferential midfoot swelling, erythema extending from the base of the toes to the midfoot, and a foul-smelling exudate—clear indicators of a deep wound infection compounded by the additional pain.<sup>4</sup> The infecting organism was subsequently identified as *Proteus mirabilis*. The sole of the right foot had a partially filled blister on the heel, with already established eschar formation observed over the midfoot, metatarsal heads, and the first two toes.

The infection precipitated a loss of metabolic control, leading to hyperglycemia (blood glucose levels ranging from 9-13 mmol/l) and a low-grade systemic fever (37.6°C). Despite these complications, peripheral arterial supply remained adequate, with all foot pulses exhibiting triphasic flow patterns on an 8 MHz handheld Doppler examination.<sup>5</sup>

## MEDICAL INTERVENTION

Systemic management became the cornerstone of the patient's care, with all other interventions carefully adjusted to prioritise achieving systemic stability. This approach necessitated hospital admission, with endocrinological support to stabilise his metabolic glucose levels, with intravenous systemic antibiotics, pain management, wound care, and hyperbaric oxygen therapy (HBOT) as adjunctive treatment.

The therapeutic mechanisms of HBOT at 2 ATA (Atmospheres absolute) include vasoconstriction in the healthy tissues surrounding a wounded area, facilitating a reduction in edema in the wound site. Concurrently, the therapy enhances micro-capillary blood flow, optimising oxygen delivery to the tissue. The improved microcirculation accelerates the healing process and enhances the penetration and potency of selected antibiotics. When HBOT sessions are administered in rapid succession, the synergistic effects bring quicker control over deep and surrounding wound infections.<sup>6</sup>

The clinical team focused on stabilising the patient systemically, utilising hyperbaric oxygen to expedite recovery while maintaining a conservative approach to wound care. In-patient care was chosen to prevent walking on the feet and to avoid overwhelming the patient and his spouse physically and psychologically during the initial intensive management.<sup>7</sup> The initial goals for managing the right foot wound were to

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prevent the spread of infection, stabilise blister roofs and necrotic patches with local antiseptic wound base layers, and control moisture aggressively using fluid-lock dressings to prevent bi-directional fluid exchange. Active debridement was deferred until the infection was under better control to minimise repetitive infection risk due to the patient still partially walking on the right foot, and to preserve as much plantar skin as possible.<sup>8</sup> In contrast, the left foot, which presented with collapsed blister roofs and no significant infection markers, was managed to preserve the blister roofs as long as possible to act as a biological wound dressing. This approach provided the patient with a stable surface for mobilisation and performing activities of daily living.

## CLINICAL PROGRESS

During his hospitalisation, the patient received five HBOT sessions over three days, with wound care procedures carried out every other day. This comprehensive and carefully coordinated approach was designed to maximise recovery while minimising the risk of further complications. Whilst hyperbaric oxygen therapy was only needed for five sessions, it had a profound impact on controlling the oedema as well as the deep and surrounding wound infection present on first admission.<sup>6</sup> See Table 1.

On discharge home, the patient started to be fully weight-bearing on the left foot, using the right heel as a balance support. Nutrition was maintained, and his glycemic control was at a reasonable level that the patient could achieve. All further interventions were done in the wound care unit as an ambulatory patient coming from home. The timeline of progress is depicted in Table 2, with the clinical decisions of each session added for context.

## DISCUSSION

This case study conveys several important clinical messages. Firstly, not all diabetic foot wounds present as ulcers over bony prominences with the classic triad of neuropathy, ischemia, and infection.<sup>3</sup> Secondly, neuropathy makes the feet vulnerable to more than unobserved pressure – in this case, severe thermal plantar burns.<sup>2,3</sup> Thirdly, this case underscores the

critical importance of early intervention and meticulous wound management to prevent the rapid progression of infection and associated systemic complications that occur due to comorbid diabetes.<sup>6,7</sup> Lastly, in some cases excision and grafting of burns is not always possible or the most appropriate management strategy – especially for the plantar and palmar surfaces, the groin area, and the face due to unique skin characteristics present in those areas. These areas may benefit significantly from hyperbaric oxygen therapy (HBOT) to stabilise wound beds through hyperoxygenation and vasoconstriction, which initiates the process of repair and regeneration within injured tissue while limiting additional surrounding tissue losses. Although HBOT should ideally commence within 24 hours of a burn, even a delay of several days averted propagating sepsis and further tissue loss in this case.<sup>6</sup> In this patient scenario, the aim was to initially secure a stable maintenance wound until the catabolic state of the wound had been reversed and the patient became optimised for healing.<sup>8</sup> Healing could then be achieved with maximal preservation of plantar skin via contraction and epidermal and dermal invagination.

## CONCLUSION

Plantar burns in a person with diabetes who lives in hot summer climates are not to be underestimated as a causative factor in diabetic foot morbidity. Many are unaware of when and how the injury occurred due to longstanding sensory neuropathy. Even when blisters appear, there is a disregard for the severity in the absence of pain. Infection rapidly sets in and a potential disaster is at hand. An interprofessional team approach is needed when plantar burn wounds involve weight-bearing parts of the foot (whether full-thickness or partial-thickness injuries). Strategies should include metabolic optimisation, preservation of non-injured plantar skin to initiate re-epithelialisation with similar skin, and the prevention of concomitant deep and surrounding wound infection as key strategies in establishing foot and lower limb safety in persons with diabetes.







## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

Table 1. The impact of hyperbaric oxygen therapy (HBOT) on deep and surrounding wound infection (All photos with permission of the patient)

Right foot dorsum before HBOT (14 July 2024)	Right foot dorsum after 2 sessions of HBOT at 2 ATA (15 July 2024)	Both feet after completion of 5 sessions of HBOT at 2 ATA (18 July 2024)	Both feet three days after completion of HBOT (21 July 2024)
			

Table 2. Timeline of wound progress for bilateral plantar burns (All photos with permission of patient)

Timeline	Right foot	Left foot	Clinical interventions
14 July 2024			<p>Topical antibiotics were stopped and changed to a systemic IV antibiotics (broad spectrum);</p> <p>Wound culture obtained;</p> <p>Random blood glucose 12.6 mmol/l;</p> <p>Hyperbaric oxygen therapy was initiated;</p> <p>Wheelchair used in hospital;</p> <p>Release of all blister fluid on the lowest point of gravity with blister roofs left intact (right heel and left foot);</p> <p>Wound care with topical antiseptics, non-adherent base layers and super absorbent non-interactive dressings.</p>
15 July 2024			<p>IV antibiotics in hospital;</p> <p>Fasting blood glucose 11mmol/l;</p> <p>Still in a wheelchair in the hospital;</p> <p>Hyperbaric oxygen therapy twice on this day;</p> <p>Wound care with topical antiseptics, non-adherent base layers and super absorbent non-interactive dressings;</p> <p>Blister roofs are stable, and no additional fluid is produced.</p>
18 July 2024			<p>The patient is at home and fully ambulatory;</p> <p>Fasting blood glucose varies between 9-13mmol/l;</p> <p>The last session of Hyperbaric oxygen therapy was completed (5/5);</p> <p>Oral antibiotics as MCS culture prescribed;</p> <p>Wound care with topical antiseptics, non-adherent base layers and super absorbent non-interactive dressings;</p> <p>Blister roofs are stable, and no additional fluid is produced.</p>









## FUNDING

The authors received no funding for this study.

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Table 2. Timeline of wound progress for bilateral plantar burns - continued (All photos with permission of patient)

Timeline	Right foot	Left foot	Clinical interventions
24 July 2024			<p>The patient is still ambulatory at home and completed his 10-day antibiotics course;</p> <p>Necrotic patches on the right foot starting to lift from the edges;</p> <p>The right heel blister roof became unstable and was debrided away as skin underneath stable enough to sustain weightbearing;</p> <p>Wound care still with topical antiseptics and super absorbent dressings on the right foot;</p> <p>The left foot is completely dry and stable with protective dry dressings only.</p>
07 Aug 2024			<p>The patient is working from home. No further antibiotic course is needed;</p> <p>Fasting blood glucose stable between 8-9mmol/l;</p> <p>Autolytic debridement process on the right foot is underway with the use of moist interactive foam dressings;</p> <p>Left foot blister roofs were removed, and the foot sole was nearly intact.</p>
13 Aug 2024			<p>Fasting blood glucose stable at 9mmol/l;</p> <p>Autolytic debridement softened all the necrotic patches on the right foot, and conservative sharp debridement could be done at the bedside;</p> <p>Lateral foot sole skin on the right now covering the 5<sup>th</sup> metatarsal head;</p> <p>The left foot remained intact despite being fully weight-bearing with shoe wear.</p>
17 Aug 2024			<p>The patient will now take over his own care for the last part of healing, due to a work-related transfer to another country;</p> <p>The care plan remains to keep the foot free of infection by using an antiseptic interactive base layer and a protective superabsorber, with dressings being done twice a week.</p>

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