

Case Report Nephrology

Post-arteriovenous fistula creation site diabetic wound in an end-stage renal disease patient on hemodialysis successfully treated with far-infrared therapy: A case report

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ABSTRACT

Wound healing in diabetic patients with end-stage renal disease (ESRD) presents significant challenges, especially following arteriovenous (AV) fistula creation for hemodialysis access. This case report describes a 63-year-old woman with ESRD secondary to diabetic nephropathy who developed a non-healing wound at the AV fistula site one month after surgery. Due to logistical limitations preventing daily wound therapy, far-infrared (FIR) therapy was incorporated into her routine hemodialysis sessions, delivered three times weekly for 40 minutes each. Remarkable improvement was observed after three weeks, and complete wound healing was achieved by the eighth week. At the six-month follow-up, the AV fistula remained patent with satisfactory dialysis adequacy and no recurrence of the wound. This case demonstrates the feasibility and clinical benefit of integrating FIR therapy into hemodialysis sessions as a practical adjunct for wound management in high-risk ESRD patients and may represent the first documented clinical implementation of this approach in Oman.

Keywords: Arteriovenous fistula, Diabetic wound healing, End-stage renal disease, Far infrared therapy, Hemodialysis

INTRODUCTION

Patients with end-stage renal disease (ESRD) and diabetes mellitus are at increased risk for impaired wound healing due to microvascular complications, diminished regenerative capacity, and a compromised immune response.^[1,2] The creation of an arteriovenous (AV) fistula, though essential for hemodialysis access, can present additional challenges in this population by triggering local tissue trauma and vascular stress, potentially leading to non-healing surgical wounds.^[3]

Far-infrared (FIR) therapy is a non-invasive modality shown to promote angiogenesis, enhance local microcirculation, support granulation tissue formation, and activate fibroblasts to facilitate wound healing – effects observed independently of changes in skin blood flow and temperature.^[4-7] While FIR therapy is not new in the context of wound management, this case is distinguished by its integration into the patient's routine hemodialysis sessions, thereby minimizing additional treatment burden and enhancing feasibility for both the patient and clinical staff.

This case report presents the successful application of integrated FIR therapy in a 63-year-old diabetic ESRD patient in Oman, with a chronic non-healing AV fistula site wound. To the best

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of our knowledge, this is the first published case in Oman demonstrating this specific approach.

CASE REPORT

A 63-year-old female with ESRD secondary to diabetic nephropathy was undergoing maintenance hemodialysis 3 times/week at a regional dialysis unit in Sultan Qaboos Hospital, Oman. One month after the surgical creation of a left upper-arm AV fistula, she developed a persistent post-operative wound at the site. The wound did not respond to standard care (sterile dressing, topical antimicrobial application) and showed no significant improvement over two weeks. Figure 1 illustrates the patient's AV fistula wound two weeks after surgery.

Treatment and clinical course

FIR protocol and intervention

Due to the patient's logistical inability to attend daily wound therapy sessions, a modified FIR therapy protocol was adopted. A FIR thermal therapy device (Firapy® FIR Therapy Unit, TY-102F Model) was used, delivering wavelengths in the 3–1000 μm range, calibrated to a surface temperature of 40–42°C, and placed at a distance of 25–30 cm from the wound area. Each session lasted 40 minutes, administered 3 times/week, concurrently with the patient's hemodialysis treatment. This protocol, adapted from established clinical studies,^[2,5] offered a safe, practical method for delivering consistent FIR therapy without requiring additional hospital visits or staffing resources.

A licensed nurse leader at the hospital, certified in the use of FIR therapy, provided hands-on training to the assigned dialysis nurse to ensure proper setup, safe operation, and monitoring during therapy sessions.

Wound assessment

The wound was assessed using the pressure ulcer scale for healing (PUSH) tool, adapted for use at AV access wound sites. Table 1 summarizes the patient's wound healing progress over 8 weeks.

Progress and outcomes

After three weeks of FIR therapy, the wound area had reduced to 3.5 cm^2 , with mild exudate and visible granulation tissue indicating positive healing progress. By 6 weeks, further improvement was observed, as the wound size decreased to 1.2 cm^2 with minimal exudate. At the end of 8 weeks, complete epithelialization was achieved, and the PUSH score reached 0, signifying full wound healing [Figure 2]. A 6-month follow-up confirmed that the AV fistula remained patent, with no recurrence of wound breakdown or infection, and dialysis adequacy was maintained with a Kt/V value >1.4 .

Table 1: Wound healing progress over 8 weeks

Date	Wound size (cm^2)	Exudate amount	Tissue type	PUSH total score
February 18, 2024 (Week 1)	6.0	Moderate	Slough	12
March 10, 2024 (Week 3)	3.5	Mild	Granulation tissue	8
March 31, 2024 (Week 6)	1.2	None	Granulation tissue	5
April 20, 2024 (Week 8)	0	None	Closed (Healed)	0

PUSH: Pressure ulcer scale for healing.

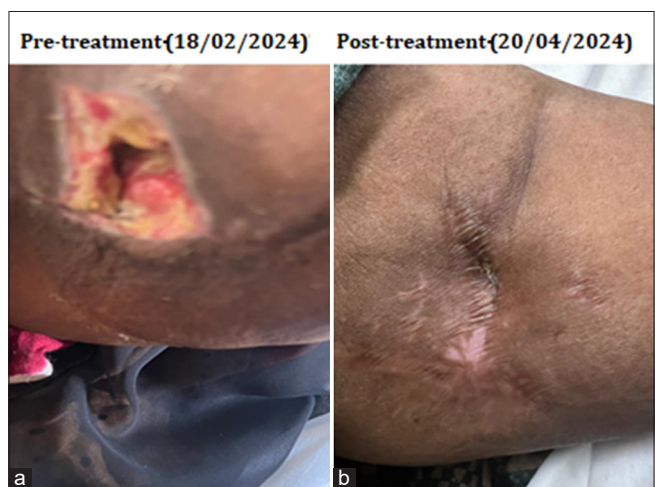


Figure 1: (a) Pre-treatment wound image, (b) Post-treatment wound image showing complete healing.



Figure 2: The far infrared therapy at week 8.

DISCUSSION

This case demonstrates a novel and practical adaptation of FIR therapy for chronic wound healing in ESRD patients, integrated into routine dialysis schedules – an approach that can improve accessibility and adherence.

Clinical challenge

Delayed wound healing is a well-documented complication among diabetic ESRD patients due to compromised

microcirculation and immune function.^[1,3,8] AV fistula surgical sites are particularly susceptible to infection, necrosis, and delayed granulation.^[3,8]

FIR mechanism and relevance to this case

The observed clinical improvements align with existing evidence suggesting FIR therapy's ability to enhance capillary blood flow and oxygenation,^[9,10] stimulate endothelial nitric oxide synthase and angiogenesis,^[4,7,11] promote granulation tissue formation and fibroblast activity,^[9,12] and modulate pro-inflammatory cytokines and accelerate resolution of local inflammation.^[4,9] These mechanisms were reflected in the observed clinical trajectory: The wound showed marked granulation by Week 3, reduction of exudate and inflammation by Week 6, and complete epithelialization by Week 8, with no recurrence at 6-month follow-up.

Practical innovation

While FIR therapy has been explored in clinical research, its integration into routine hemodialysis sessions has not been widely implemented. This approach offers a time-efficient, cost-effective, and patient-friendly option, especially in resource-constrained settings like regional hospitals in Oman.

Contribution to regional practice

This is the first known case from Oman that documents successful AV fistula wound healing through integrated FIR therapy in an ESRD patient. It supports the potential for scaling this approach across similar hemodialysis units in the region, especially where patients face access or mobility barriers.

Patient perspective

The patient expressed satisfaction with the combined treatment, noting that the integrated approach reduced the need for separate hospital visits and effectively resolved the chronic wound issue that had previously caused discomfort and concern.

CONCLUSION

This case highlights the effectiveness and practicality of integrating FIR therapy into routine hemodialysis sessions for the treatment of chronic, non-healing AV fistula wounds in high-risk diabetic ESRD patients. Over 8 weeks, objective wound scoring confirmed significant improvement leading to complete healing, with sustained fistula patency at six months.

Our findings from Oman are consistent with international experiences. In Taiwan, preclinical studies demonstrated accelerated diabetic wound closure through angiogenesis promotion and inflammation reduction. In Japan, FIR applied

through Waon therapy successfully healed a refractory digital ulcer within six weeks. In Malaysia, the Ministry of Health acknowledged FIR as a promising adjunct for vascular access wound care, while in Pakistan, FIR contributed to improved healing outcomes in burn wounds by reducing scarring and tissue stiffness.

Although current evidence is still limited, the accumulating results across different healthcare systems are promising. Future multicenter collaborations and international case series are strongly recommended to validate these findings, generate larger patient cohorts, and ultimately establish standardized, evidence-based recommendations for the clinical use of FIR therapy in wound management among ESRD and other high-risk populations.

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