

Application of portable topical oxygen therapy: a case report

Abstract

Diabetic foot ulcers often have difficulty healing due to low tissue oxygenation, which affects their regenerative capacity. Topical oxygen therapy is a novel tool for wound treatment in patients with diabetic foot because it promotes wound healing by increasing angiogenesis, fibroblast activity, and collagen synthesis.

The objective: It is to describe the evolution of a dehiscent wound in a diabetic patient.

Methodology: A clinical case describes the approach to treatment and the application of the continuous transdermal oxygen therapy device.

Results: In five weeks we have achieved a reduction in the size of the lesion and its re-epithelialization.

Conclusions: The supplemental oxygen provided with this therapy has helped us increase angiogenesis, accelerating wound perfusion, epithelialization, and wound closure.

Keywords: continuous transdermal oxygen therapy, oxygen, diabetic foot, wound healing, wound care, vascular ulcers, hypoxia, infection, diabetic foot ulcer, pain, non-healing wound, wound size

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Introduction

Diabetic foot ulcers are one of the most common and serious complications of diabetes mellitus.¹ It can be stated that between 40 and 70% of lower limb amputations occur in diabetic patients.^{2,3} Oxygen is essential for the healing of these wounds. Its absence, or hypoxia, can delay this process, especially in individuals with comorbidities. Blood oxygen levels are frequently insufficient in patients with chronic wounds due to poor circulation, vascular disruption, and vasoconstriction, which reduces the healing capacity.⁴ Supplemental oxygen accelerates angiogenesis⁵ by increasing wound perfusion and epithelialization.

Aim

- Describe the evolution of a dehiscent wound in a diabetic patient.
- Expose the NATROX therapeutic approach that can help other professionals understand the importance of using this device as a complementary treatment.

Specific objectives

- Reduce the size of the wound in the shortest possible time
- Reduce pain
- Achieve re-epithelialization of the wound.

Case presentation

We present the case of a diabetic patient who was referred to our clinic for evaluation of a dehiscent post-surgical wound that had developed three months earlier, following a right infracondylar amputation.

Medical record: Type II diabetic, Dyslipidemia, Poorly controlled high blood pressure, chronic lower limb ischemia. He underwent femoropopliteal bypass surgery on his right lower limb. He suffered

a worsening of ischemia due to obstruction and deterioration of the bypass, necessitating an infracondylar amputation of that limb. Active drinker and smoker.

Physical condition: Totally dependent. Uses a wheelchair for mobility.

Exploration

Three-month postoperative dehiscent wound in a patient with a right infracondylar amputation.

I. Main lesion located on the right stump: Size: 3 x 2.5 cm, cavitated. (Figure 1)

II. Two more superficial lesions. (Figure 2)

Size: 1.3 x 1 cm.

Size: 2 x 2.3 cm



Figure 1 It presents 70% granulation tissue in the bed and 30% devitalized tissue, well-defined borders, with moderate serous exudate and no foul odor. There are no signs of infection. The perilesional area is intact.



Figure 2 Two more superficial lesions.

For several months, no progress has been observed with conventional topical treatments. Due to the lack of progress in wound closure, with the likelihood of continued wound hypoxia due to small vessel disease, chronic inflammation, etc., it was decided to initiate local transdermal oxygen therapy. Before starting treatment, a holistic and thorough assessment of both the patient and the wound was performed. It is vitally important to properly prepare the wound so that there is full contact between the oxygen therapy device and the wound bed. The use of the acronym TIME (moist healing) allowed for a comprehensive approach to the different factors that can delay the healing process. (Control of devitalized tissue, Achieving bacterial control and optimal moisture management).^{6,7}

III. We start Cures three times a week

- i. Cleaning by irrigation with saline solution to remove the remaining devitalized tissue.
- ii. Polyhexamide biguanide foment: Solution for washing wounds, with cleaning and decontamination capacity of the tissue surface
- iii. Debridement: This was initiated with sharp debridement (Figure 1). (VAS pain scale: 8). An enzyme ointment was also used as a chemical debridement.

Once the wound bed was free of devitalized tissue, there were no obvious signs of infection, and exudate control was achieved, and local oxygen therapy was administered to stimulate wound healing.

IV. Cures were performed once a week. (Figure 3–5)



Figure 3 Using aseptic technique, the oxygen distribution system was placed directly on it.



Figure 4 The system was covered with a hydropolymeric dressing with silicone adhesive edges, sealing the edges to capture oxygen generated by the system.



Figure 5 We then connect the generator to the oxygen distribution system.

Using the device at home allowed for patient empowerment by involving them in the treatment. The wound had progressed significantly, managing to reduce its size (Figure 6 & 7). A decrease in the dehiscence area was observed, with an increase in granulation tissue, complete absence of devitalized tissue and decreased pain (VAS scale: 1). (Figure 8)

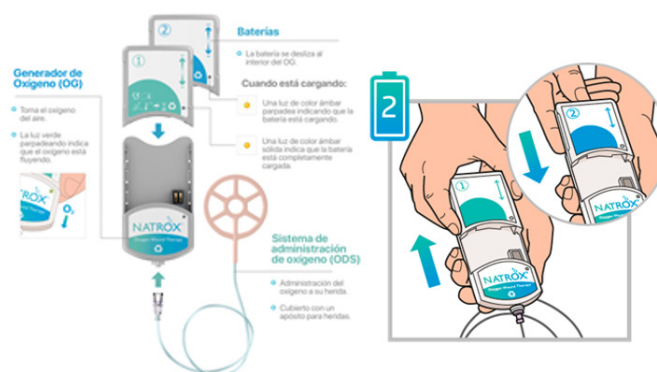


Figure 6 The device is easy to use, the patient was educated in its use (changing the batteries daily, recharging them) and its operation was explained.



Figure 7 A decrease in the dehiscent area was observed.



Figure 8 Local treatment was then instituted, applying povidone-iodine until the wound was completely closed.

Results

Continuous transdermal oxygen therapy has proven to be an effective treatment in the clinical case described. Significant benefits were observed, including a reduction in wound size, acceleration of the healing process, and an improvement in the patient's quality of life, with a reduction in the number of dressings (one per week), reduction in pain during dressings (VAS scale), and fewer trips to the hospital.

Discussion

Diabetic patients often experience complications that hinder the healing process. Diabetes negatively affects blood circulation, resulting in decreased blood flow to the extremities. This compromises the delivery of nutrients and oxygen to wounds, thus prolonging the healing process and increasing the risk of complications, such as infections and chronic ulcerations. Providing oxygen directly to the ulcer area promotes cell proliferation, facilitates the formation of new blood vessels and connective tissue, and helps fight infection, which accelerates the healing process. In diabetic patients, wounds resulting from amputations are very difficult to treat due to the lack of distal blood flow. In this situation, the use of local oxygen therapy has been a viable, safe, reproducible, and successful alternative.⁶

It has been proven to be an effective therapy for treating hard-to-heal wounds, offering new hope for patients suffering from these chronic and debilitating conditions. As we progress, we're likely to discover even more applications and benefits of this therapy in the medical field. Therefore, we must continue working in this line and generate more scientific evidence of the application of this

therapy and continue to disseminate it continuously so that nursing professionals can apply it to our patients, improving their care.⁷ Evidence-based recommendations support the effectiveness of topical oxygen therapy (TOT) in the management of diabetic foot ulcers, which is revolutionizing treatment approaches worldwide.⁸ There are studies that have documented that topical oxygen therapy in wounds is useful in rescuing ischemic lower limbs. It is vital to approach each case individually and with a multidisciplinary approach to maximize the benefits of this therapy. Considering these aspects will allow for comprehensive and personalized care, thus optimizing the outcomes of chronic wound treatment for patients.

Conclusion

Diabetic foot requires a multidisciplinary approach, as the limb can undergo many changes. Numerous studies show that without adequate tissue oxygen levels, wounds are very difficult to heal. Adding supplemental topical oxygen can help initiate the healing process in these types of injuries. Topical oxygen therapy, included in multidisciplinary treatment, increases the patient's functional capacity and reduces social costs. It should be considered as an adjuvant treatment for patients with difficult-to-heal wounds.

Acknowledgments

None.

Ethical considerations

This study is conducted in accordance with the Declaration of Helsinki, good clinical practice principles, and the Universal Declaration of Human Rights. The respect, confidentiality and anonymity of the participant were guaranteed in accordance with the provisions of Regulation (EU) 2016/679 of April 27 on the protection of natural persons with regard to the processing of their personal data and with Organic Law 3/2018 of December 5 on the Protection of Personal Data and Guarantee of Digital Rights¹⁰. (10. Terrón Santos D, Domínguez Álvarez JL. Regulation (EU) 2016/6 of the European Parliament and of the Council of April 27, 2016 on the protection of natural persons with regard to the processing of personal data and the free movement of such data, and repealing Directive 95/46 / EC (General Data Protection Regulation). *Ars Iuris Salmanticensis*. 2019; 7 (1): 223-8. [Links] Oral and written consent was obtained from the patient before performing any procedure related to the clinical case. The principles of nonmaleficence and beneficence established for conducting research with human subjects were followed.

Conflicts of interest

The author declared that there are no conflicts of interest.

References

1. Reparaz L, Sánchez P. The diabetic foot. *An Med Interna*. 2004;21(9):5–7.
2. Gómez E, Esther A, Díaz A, et al. Diabetic foot. *Seminars of the Spanish Rheumatology Foundation*. 2012;13(4):119–129.
3. Simón E, Mellado MA, Rodríguez JJ, et al. Multidisciplinary approach to neuroischemic ulcers; a case report. *Rev Esp Podol*. 2020;31(1):55–61.
4. Inotec AMD Ltd. NATROX Oxygen wound therapy – Product Monograph. 2019.
5. Knighton DR, Silver IA, Hunt TK. Regulation of wound-healing angiogenesis: effect of oxygen gradients and inspired oxygen concentration. *Surgery*. 1981;90(2):262–270.

6. Yu J, Lu S, McLaren AM, et al. Topical oxygen therapy results in complete wound healing in diabetic foot ulcers. *Wound Repair Regen.* 2016;24(6):1066–1072.
7. Gordillo GM, Sen CK. Evidence-based recommendations for the use of topical oxygen therapy in the treatment of lower extremity wounds. *Int J Low Extrem Wounds.* 2009;8(2):105–111.
8. Yamile Jubiz, Nieto Marin, Bernal Ocampo, et al. Expert consensus on the clinical efficacy and guidelines for continuous transdermal oxygen therapy for the healing of complex or difficult-to-heal wounds. *Journal of Wound Care.* 2023.