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CASE REPORT

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Fractional CO_2 laser-assisted topical rifamycin drug delivery in the treatment of pediatric cutaneous leishmaniasis

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Abstract

Cutaneous leishmaniasis is challenging to treat. Various drugs have been proposed to manage this condition, with variable results. In this case report, we describe laser-assisted delivery of rifamycin to treat this infection. Two sessions of fractional CO_2 laser were performed one month apart. Each was followed by a topical application of rifamycin for three days. Resolution with minimal scarring was obtained, suggesting this technique might be safe and effective in treating cutaneous leishmaniasis.

KEYWORDS

cutaneous leishmaniasis, laser-assisted drug delivery, topical rifamycin

1 | INTRODUCTION

Protozoan species of the genus *Leishmania* cause leishmaniasis.[1] Localized cutaneous leishmaniasis (CL) is the most common form affecting humans. No single universal treatment is found for CL, and some treatments may cause systemic toxicity.[2] In addition to drug therapy, there has been growing interest in lasers and related techniques in recent years. The mechanism of action of the CO_2 (10 600 nm) laser in CL is related to specific thermolysis of the targeted tissue with no significant side effects.[3,4] Lesions heal within a few days with an acceptable cosmetic result. We proposed using laser-assisted drug delivery (LADD) with an ablative fractional CO_2 laser because it is capable of producing microscopic channels that can convey the drug to the dermis.[5] This technique has previously been used in different pediatric dermatological conditions to transfer various drugs through the epidermis.[6] Rifamycin is an antibiotic used to treat several types of bacterial infections, and several antibiotics of its family have been used orally or intravenously for CL for several years.[7] Rifamycin solution is more suitable for LADD than cream formulations.[8]

2 | CASE REPORT

A 9-year-old female patient presented with a histopathologically confirmed diagnosis of CL. She had a 0.7 × 0.6 cm nodular lesion on the nasal root. The lesion was present for more than a year and was non-healing, erythematous, soft, and non-tender, with a central scar (Figure 1A,B).

Ablative fractional CO_2 laser (Deka Laser SmartXide[2] DOT/RF® Deka Mela, Calenzano, Italy) treatment (power 5 W, spacing 500 μm, dwell time 1500 μs, fluence 2.46 J/cm^2, pulse energy 17.8 mJ) was performed on the lesion. Topical anesthetic cream (Pliaglis® Difa Cooper S.p.A. Caronno Pertusella, Italy) was applied one hour before each treatment. Topical 0.5% rifamycin solution (Rifocin® solution 90 mg/18 mL, Sanofi-Aventis S.p.A.) was applied on the treated area every 4 hours after treatment for the first 16 hours and then twice a day for the following two days (Figure 2). No other topical ointments were used after the procedure. After one month, we performed another laser session with subsequent application of topical rifamycin, using the same protocol.

Clinical improvement was already noted at one-month follow-up. Eight months after the second session, the lesion had disappeared entirely, leaving a cosmetically acceptable scar in the treated area (Figure 3A,B). No local or systemic side effects were reported.

3 | DISCUSSION

It is often difficult to find a treatment for CL. Drug therapy, when available, is often non-curative and has numerous potential side effects.

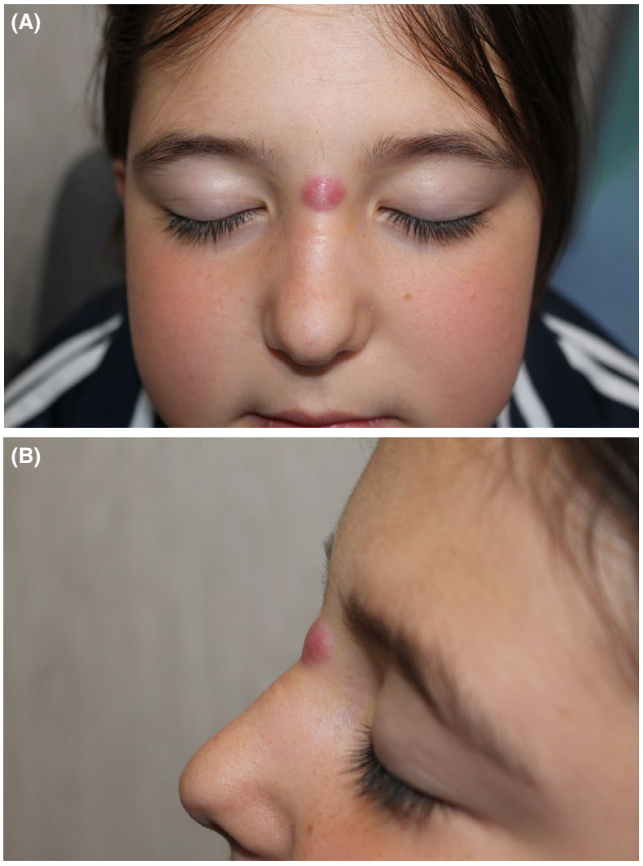

FIGURE 1 A, Baseline, frontal view. B, Baseline, lateral view

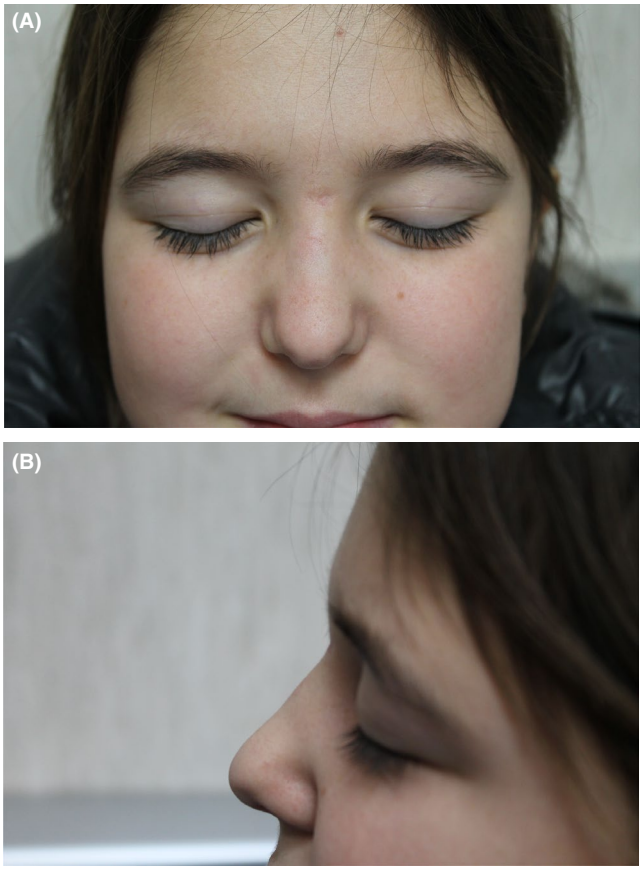

FIGURE 3 A, Eight months after the first session, frontal view. B, Eight months after the second session, lateral view

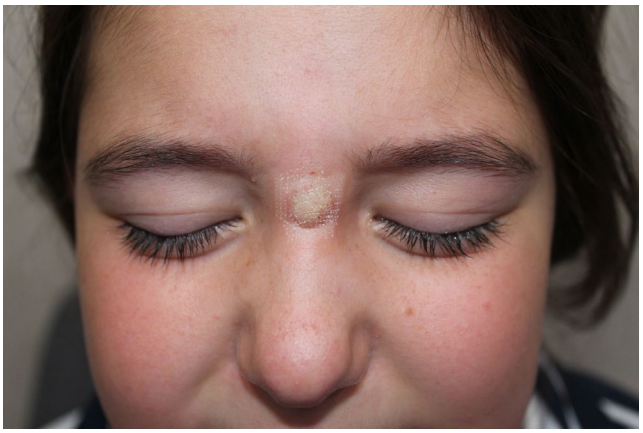

FIGURE 2 Immediately after the first laser session, frontal view

Among drugs used with varying degrees of success, the most commonly prescribed treatments are antimonials.[9] Other drugs, such as antibiotics or antimycotics, have also been proposed.[10,11] Oral rifampicin, a molecule of the rifamycin family, has been used to treat CL at a dose of 10 mg/kg per day in two equally divided doses during meals for 4-6 weeks in children and adults with an effectiveness of 83.4% in the pediatric population.[12]

Rifampicin is capable of reducing in vitro the growth of Leishmania major promastigotes and amastigotes. However, the use of this drug is linked to various systemic side effects, such as hypersensitivity reactions, gastrointestinal and hepatic manifestations, and reddish-orange discoloration of body tissues with permanent staining[13] Finding an effective topical treatment without side effects is still a great challenge today. Treatments based on thermotherapy, cryotherapy, photodynamic therapy, CO_2 laser, and paromomycin have been previously proposed.[12] The flashlamp-pumped pulsed dye laser has been reported to successfully treat CL.[14] In addition, several authors have used the CO_2 laser to treat cutaneous leishmaniasis successfully.

The concept of transdermal drug delivery involves the assisted transport of molecules through the epidermis using various physical methods. It is a promising way to increase drug absorption compared with topical application. Various methods have been proposed to enhance drug absorption with transdermal delivery, such as scraping, dermabrasion, micro-needling, pressure waves, vacuum effect, radiofrequency, or lasers.[15] The use of CO_2 ablative devices in fractional mode to enhance the penetration of some drugs has already been proposed by other groups.[11,16]

The same approach, with two CO_2 laser sessions performed with a one-month time interval, was proposed by Basnett et al in 2015 with similar results, although the drug was different (paromomycin), and it was applied daily for the entire duration of treatment, instead of only right after fractional laser treatment.[11] CO_2 laser has proven to be more effective and with fewer side effects, such as pain, burning sensation, secondary infections, and necrosis (4.5% vs. 24%) than intralesional meglumine antimoniate (MA) and resulted in a shorter healing time (one month vs. three months).[17]

Laser parameters in LADD need to be adjusted from patient to patient, based on drug, skin condition, and lesion location.[15] A fractional CO_2 laser can generate superficial (225 μm; 17.5 mJ/channel) and deep (1200 μm; 130.5 mJ/channel) channels.[18] Specifically, the fractional CO_2 laser system generated channels up to 1800 μm deep in this case. The drug was delivered to the dermis through these channels, although no or minimal ablative effect was generated by this procedure, in contrast to what happens typically with ablative CO_2 laser devices. We decided to perform one session every month up to the lesion's resolution, which occurred after two sessions, as it has previously been proposed in other LADD treatments of CL.[11,16]

The compromised integrity of the epidermis accelerates the absorption of topicals. Lipophilic molecules have a greater intrinsic capability to pass through the epidermis.[19] Therefore, we decided to use rifamycin, as the drug is very lipophilic and particularly useful in the pediatric population.

With no side effects and complete clearance of the lesion, the therapeutic outcome makes this approach very appealing for the treatment of pediatric CL.

4 | CONCLUSION

Our results in one case show that CL may be effectively treated with LADD. The CO_2 laser was used in this patient to transfer topical rifamycin directly to the lesion, without any local or systemic side effects, and with a satisfactory final cosmetic outcome. This approach seems to be a safe and promising treatment for CL in children, but further studies are necessary to confirm the effectiveness of these results.

CONFLICT OF INTEREST

No conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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