Koebnerization phenomenon after broadband light therapy in a patient with cutaneous sarcoidosis

Jaclyn Chesner, BA,[a] Melissa Kanchanapoomi Levin, MD,[b,c] and Ellen S. Marmur, MD[b,c]
Philadelphia, Pennsylvania, and New York, New York

Key words: aminolevulinic acid; broadband light; intense pulse light; interleukin-1; koebnerization; photodynamic therapy; sarcoidosis.

INTRODUCTION

Sarcoidosis is an inflammatory disease characterized by noncaseating epithelioid cell granulomas. Skin involvement is seen in approximately one-quarter of patients. Multiple cutaneous variants in sarcoidosis include lupus pernio, Lofgren syndrome, Darier-Roussy, and erythematous papules and nodules arising within pre-existing scars. Treatment consists of potent topical steroids, intralesional corticosteroids, systemic corticosteroids, antimalarial agents, and methotrexate.[1] More recently, in-office treatments involving light-based therapies such as photodynamic therapy (PDT), intense pulse light (IPL), and broadband light (BBL) are being used. Additionally, vascular laser treatments including the pulse dye laser (PDL) and fractionated resurfacing lasers have produced significant improvement in cutaneous sarcoidosis.[2-6] As with other inflammatory skin conditions, such as lichen planus, vitiligo, and psoriasis, sarcoidosis can exhibit the koebnerization phenomenon. Laser surgeons need to be aware of this potential complication when treating cutaneous sarcoidosis. Cases of adverse reactions to light- and laser-based devices are rare but are characterized by crusting, scabbing, blistering, scarring, hyperpigmentation, hypopigmentation, bruising, or incomplete response.[7] We present a case of a bullous reaction with koebnerization after BBL therapy in a patient with good response in the past to BBL treatments. We also review the literature regarding various light-based treatments for cutaneous sarcoidosis.

Abbreviations used:

ALA:	aminolevulinic acid
BBL:	broadband light
IPL:	intense pulse light
Nd:YAG:	neodymium-doped yttrium aluminium garnet
PDT:	photodynamic therapy

CASE

A 45-year-old woman, with a medical history of systemic pulmonary and cutaneous sarcoidosis on the right cheek and right distal pretibial region presented for a fifth BBL treatment of erythematous plaques and papules on her right cheek. She was not on any medications for treatment of sarcoidosis and was without new lesions. The patient underwent a BBL treatment with a 560-nm filter at 20 J/cm^2, pulse width of 30 milliseconds, 20°C cooling, 7-mm square spot size, and repetition rate of 10 Hz (Sciton Inc, Palo Alto, CA). She had previous treatments with BBL at the same settings, resulting in improvement without any complications. Within the hour after the treatment, bullae developed in the treatment area (Fig 1). The patient reported no direct sun exposure, recent tanning, new medications, or a history of trauma to the area before the light treatment. She was started on hydrocortisone 1% cream and frequent emollients with vigilant sun protection. Several weeks after resolution of the bullae, new sarcoidal plaques and papules developed in the same area. The patient did not return for follow-up for 9 months

From Drexel University College of Medicine, Philadelphia[a]; Department of Dermatology, Icahn School of Medicine at Mount Sinai, New York[b]; and Marmur Medical, New York.[c]
Funding sources: None.
Conflicts of interest: None declared.
Correspondence to: Melissa Kanchanapoomi Levin, MD, 12 East 87th Street, Suite 1A, New York, NY 10128. E-mail: melissa.levin@marmurmedical.com.

JAAD Case Reports 2017;3:306-9.
2352-5126

http://dx.doi.org/10.1016/j.jdcr.2017.03.014

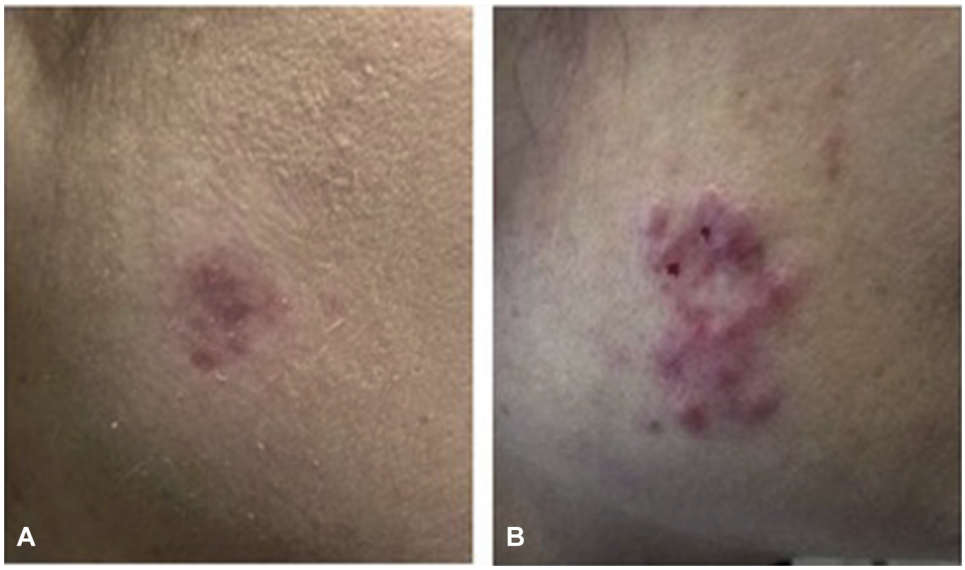

Fig 1. A 45-year-old woman with cutaneous sarcoidosis at (**A**) baseline before treatment and (**B**) with koebnerization after BBLT (560 nm filter at 20 J/cm^2, pulse width 30 msec, 20°C cooling, 7-mm square spot size, repetition rate 10 Hz).

after the last BBL treatment. At the time of re-presentation, she had one lesion treated with intralesional triamcinolone (2.0 mg/mL [0.2 cc]) and started on flurandrenolide tape nightly to the site. The patient returned for a series of additional intralesional corticosteroid injections with slight to minimal improvement.

DISCUSSION

Traditional treatment options for localized cutaneous sarcoidosis have relied on intralesional corticosteroid and cryotherapy. However, with the advancement of light-based technologies, the treatment options for localized granulomatous cutaneous disorders have expanded. Novel in-office treatments include PDT, vascular lasers, BBL, and IPL.[1]

PDT generates reactive oxygen species through the interaction of a photosensitizer, the appropriate wavelength, and oxygen to induce necrosis or apoptosis of selected cells. PDT is used most often to treat actinic keratosis, superficial nonmelanoma skin cancers, photoaging, acne, and verrucae.[8] More recently, PDT has been used to treat cutaneous sarcoidosis. In one study, a patient with cutaneous sarcoidosis who had been treated unsuccessfully with corticosteroid and cryotherapy underwent PDT with topical aminolevulinic acid (ALA) in combination with IPL (IPL-ALA-PDT). The patient received a total of 5 treatments in 2-week intervals and showed no sign of plaque recurrence 6 months after the last treatment.[2] It is hypothesized that ALA destroys endothelial cells and macrophages that produce the primary pro-inflammatory cytokines responsible for granuloma formation, interleukin-1 and tumor necrosis factor-α.[2] By decreasing interleukin-1 and tumor necrosis factor-α production, sarcoidal granuloma formation is minimized. In another study, a 42-year-old woman with a sarcoidal plaque on her forehead, who did not respond to oral and topical steroids, underwent 7 sessions of ALA-PDT. There was progressive improvement throughout all treatments.[9] PDT is an effective treatment option for cutaneous sarcoidosis with few adverse effects that may include pain, photosensitivity, and temporary postoperative erythema, burning, and discomfort.[2]

An alternative to PDT for the treatment of cutaneous sarcoidosis is vascular lasers such as PDL. It is theorized that PDL uses selective photothermolysis to target blood vessels. It penetrates only to a 2-mm depth into the skin with yellow light wavelengths that are absorbed by oxyhemoglobin and deoxyhemoglobin. An advantage to the vascular targeting is its ability to preserve the surrounding healthy tissue.[4] Soleymani and Abrouk[4] highlight a case of biopsy-proven lupus pernio, cutaneous sarcoidosis, and scar sarcoid, each successfully treated with PDL. The patient with lupus pernio underwent 6 sessions of PDL (585-nm wavelength at 6.6 J/cm^2, 5-mm spot size) spaced 6 weeks apart for erythema and telangiectasias on her nose. After completing treatment, the erythema was significantly reduced without adverse side effects. Compared with the initial biopsy, a biopsy of the treated lesion found a reduction in vascularity with persistence of noncaseating granulomas, indicating the PDL targeted the blood vessels

for favorable cosmetic results but did not treat the sarcoidosis.[4] Roos et al[5] outlines another successful case report of a patient with histologically proven cutaneous sarcoidosis who was treated with flashlamp-pumped pulse dye laser. The patient had progressively growing nodules on her back. Flashlamp-pumped pulse dye laser (585 nm wavelength at 6 J/cm^2, 12-mm spot size) was used on 2 test sites, and, when compared 4 weeks later, there was complete remission at the test sites and continuous growth of the surrounding lesions. The remaining sites were subsequently treated and exhibited complete resolution after 4 weeks with only slight erythema remaining and no recurrence at 28 weeks of follow-up.[5] Another vascular laser that has shown promising results for cutaneous sarcoidosis is neodymium-doped yttrium aluminium garnet (Nd:YAG) laser. Unlike PDL which can penetrate only to shallow depths, Nd:YAG penetrates 75% deeper to target deeper vasculature.[4] A case of biopsy-proven cutaneous sarcoidosis referenced by Soleymani and Abrouk[4] was treated with 2 sessions of frequency-doubled Nd:YAG (585-nm wavelength, 50-ms pulse duration, 12-16 J/cm^2) and exhibited almost complete resolution of plaques on her cheeks, no side effects, and no sign of relapse at three years follow up.[4]

IPL uses selective photothermolysis to destroy the target area by emitting photons into the skin that are absorbed by exogenous or endogenous chromophores. Traditionally, it is used to treat pigmentation disorders, hair removal, and acne, but similar to PDT, IPL/BBL is now being used to treat other inflammatory conditions including rosacea, hidradenitis suppurativa, discoid lupus, and sarcoidosis. IPL is used as the light source because it is able to penetrate a greater depth and generate photodynamic reactions more extensively than many other light-incoherent sources.[2,8] Selective photothermolysis allows IPL/BBL to target specific chromophores such as melanin and hemoglobin. In the case of sarcoidosis and other inflammatory skin conditions, the target is hemoglobin. On the other hand, PDT differs by generating reactive oxygen species, which secondarily causes apoptosis of cells.

A clinical study using IPL to target each of these inflammatory dermatoses found positive results for all conditions. In particular, a patient with sarcoidosis presented with 3 painful, firm, vascular nodules on the anterior and posterior pinna and on the helix. The patient did not respond to previous intralesional corticosteroid therapy and was then treated successfully with a series of 3 IPL sessions. IPL settings were 2 pulses at 12 to 16 J/cm^2 with the 500-nm filter and pulse duration of 5 to 10 milliseconds. There was significant reduction of the nodules with reduction of pain. The patient underwent a total of 4 treatments with no sign of recurrence 6 months after the last treatment.[3]

A benefit of IPL or BBL is that the physician can adjust the wavelength filter, energy emitted, pulse duration, and repetition rate to suit their patient's skin type, and skin disease and potentially limit adverse side effects. Unfortunately, in our case presentation, a bullae formed after the IPL/BBL treatment. It is unclear why the patient had a bullous reaction in the treatment area given the prior satisfactory responses and the cooling mechanism. It is possible that such a reaction occurred as a complication to the IPL/BBL treatment, or the light therapy was a trigger for sarcoidosis to flare. Given the instant formation of the bullae shortly after the IPL/BBL treatment, the authors favor a potential complication to the IPL/BBL treatment. Furthermore, the bullae then triggered a koebnerization response with development of new sarcoidal plaques. Rare manifestations of sarcoidosis have been reported with bullae. One case study documented a patient with biopsy-proven pulmonary, lymph node, liver, and joint sarcoidosis who achieved clinical remission after being treated with an oral glucocorticosteroid. Six months after discontinuation of systemic glucocorticosteroid, the patient presented with a bullous eruption in tattooed areas of her skin, consistent with cutaneous sarcoidosis.[10] Therefore, although IPL/BBL treatments can effectively treat localized cutaneous sarcoidosis, complications can occur even in the setting of quiescent cutaneous sarcoidosis.

There are multiple light-based devices to treat localized cutaneous sarcoidosis safely and effectively. Nonetheless, laser surgeons should be aware of the koebnerization phenomenon of sarcoidosis. We recommend treatment with intralesional corticosteroids to resolve the exacerbation, and caution should be exerted when performing any light-based treatments.

REFERENCES

1. Doherty CB, Rosen T. Evidence-based therapy for cutaneous sarcoidosis. *Drugs*. 2008;68(10):1361-1383.
2. Hasegawa T, Suga Y, Mizuno Y, Haruna K, Ikeda S. Photodynamic therapy using intense pulsed light for cutaneous sarcoidosis. *J Dermatol*. 2011;39(6):564-565.
3. Piccolo D, Di Marcantonio D, Crisman G, et al. Unconventional use of intense pulsed light. *Biomed Res Int*. 2014;2014:1-10.
4. Soleymani T, Abrouk M. Laser therapy for cutaneous sarcoidosis: a review. *J Surg Dermatol*. 2016;1(1).
5. Roos S, Raulin C, Ockenfels HM, Karsai S. Successful treatment of cutaneous sarcoidosis lesions with the flashlamp pumped pulsed dye laser. *Dermatol Surg*. 2009;35(7):1139-1140.

6. Wilsmann-Theis D, Bieber T, Novak N. Photodynamic therapy as an alternative treatment for cutaneous sarcoidosis. *Dermatology*. 2008;217(4):343-346.
7. Alam M, Warycha M. Complications of lasers and light treatments. *Dermatol Ther*. 2011;24(6):571-580.
8. Rkein AM, Ozog DM. Photodynamic therapy. *Dermatol Clin*. 2014;32(3):415-425.
9. Patterson C. Successful treatment of cutaneous sarcoid by photodynamic therapy with minimal discomfort using a fractionated dosing regime. *Photodermatol Photoimmunology Photomed*. 2009;25(5):276-277.
10. Caramaschi P, Ravagnani V, Bambara LM, Biasi D. Clinical images: recurrence of sarcoidosis heralded by bullous reaction within tribal scarification. *Arthritis Rheum*. 2010;62(10):2940.