A retrospective review of light- and laser-based management of hidradenitis suppurativa

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Abstract
Hidradenitis suppurativa (HS) is a chronic skin disease that is difficult to manage and often refractory to medical management. Light and laser therapies have been utilized in the field of dermatology to treat a variety of skin conditions, but more recently were studied in the management of HS. Usually performed as outpatient procedures with a low risk of complications, they offer several advantages to traditional cold knife surgical procedures. We reviewed the various light- and laser-based treatments studied in HS and compared their efficacy. Outcome measures were not standardized, which made comparison difficult. Studies performed were few in number and often limited by small patient samples. Larger, randomized controlled trials that compare these treatment modalities to medical and surgical management are needed. Despite their limitations, light- and laser-based therapies are promising treatment options for patients with refractory HS.

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Hidradenitis suppurativa (HS) is a chronic and recurrent disease for which few effective treatments exist. This condition is often refractory to medical management. The Hurley scoring system is the most commonly used method to grade disease severity and has 3 stages.[1] Hurley stage I is characterized by at least one recurrent abscess without sinus tract formation. In stage II disease, there are multiple recurrent abscesses with sinus tract formation. Stage III is the most severe with interconnecting sinus tracts affecting an entire anatomic location where normal skin does not separate the involved region. Treatment is tailored to the patient, depending on the stage of disease. Earlier stage disease may benefit from a trial of topical or systemic therapy. Surgical options are usually reserved for advanced-stage disease with tract formation and include: incision and drainage, excision with primary closure, marsupialization, deroofing of sinus tracts, radical excision with healing by secondary intention, split-skin grafting, and laser treatments.[2,3] Advanced disease with interconnecting sinus tracts is usually treated with wide surgical excision.[3,4] Cold knife surgical procedures are prone to complications such as residual scarring, disease recurrence and restricted range of motion. The invasive nature of surgical interventions and the associated risks of postoperative infection or bleeding may not be reasonable for all patients.

Advances in laser technology, combined with their increasing versatility in the management of dermatologic conditions, have sparked interest in their utility for HS patients. Light and laser therapies target and destroy hair follicles and sebaceous glands and debulk tissue, which may alter HS disease course and decrease the number of painful flares.[5]

Intense-pulsed light

Intense pulsed light (IPL) therapy emits high-energy, polychromatic, incoherent light.[6] IPL has been used to treat acne vulgaris,[7] which has similarities in disease pathogenesis to HS. Its mechanism of action in HS has yet to be elucidated but may involve alterations of transforming growth factor-beta, superoxide dismutase and matrix metalloproteinase, which may affect the inflammatory response.[8,9] Similar to other laser therapies, IPL damages hair follicles and may also have antibacterial effects.[9]

Few studies have evaluated the efficacy of IPL for HS. Highton et al treated 18 patients with bilateral Hurley stage II or III disease in a prospective study with IPL (420 nm, fluence 7-10 J/cm^2, pulse width: 30-50 ms) to the unilateral axilla, groin, or inframammary fold twice weekly for 4 weeks, with the contralateral body site serving as a control.[9] Treatment response was assessed using a scoring system based on disease severity developed by Sartorius et al.[10] A 33% reduction in Sartorius score as compared to baseline was observed on average across all treatment sites one year after treatment, as compared to only a 3% score reduction on the control side. This improvement in disease state on the treatment side was found to be statistically significant. Long-term outcomes past 12 months are not known, but disease improvement declined over the year-long follow-up period suggesting that more treatment sessions may be necessary to prevent recurrence. While this study does demonstrate efficacy of the IPL device, it is limited by a small sample size, and fails to mention response based on Hurley stage.[9]

Piccolo et al described the use of a 500 and 550-nm filter IPL treatment for HS in 2 patients, one with Hurley stage I disease and the other with Hurley stage II disease. Both were treated with 4 sessions every 15-20 days and 2 additional sessions with double pulses of 5 ms and 10 ms (fluence 9 J/cm^2). Complete removal of the inflammatory component of HS, as well as hair removal, was achieved in these 2 patients. Limitations of this study include the small number of patients, lack of long-term follow-up and failure to use an objective measure of clinical improvement.[11]

There are many advantages to IPL therapy. The parameters of IPL therapy can be easily modified, including pulse duration, fluence and wavelength, which allow physicians to customize treatment. The therapy is noninvasive with a low risk of pain, scarring and other complications, and cooling or topical anesthetic cream can provide relief if needed. When compared to lasers, IPL devic-

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es cost less and have larger spot sizes that can more quickly treat larger areas of skin. In contrast to surgical therapies, there is less downtime after the procedure and hospitalization is not required.[12]

Unfocused light and varied fluence are 2 disadvantages of IPL therapy. Gel is required, which prevents immediate observation of clinical response.[6] The risk of thermal injury may be higher, especially in darker skin types, if attention is not paid to wavelengths used. Pigmentary changes may be permanent, but can be prevented by adjusting the fluence rate and spot size. While the IPL device has several modifications, physicians need significant knowledge about the device in order to appropriately target treatment, which may deter them from using the device. Overall, IPL may be a promising treatment for HS, however, larger, randomized controlled studies are needed to verify treatment results and further clarify the treatment algorithm.

Photodynamic therapy

Photodynamic therapy (PDT) involves application of a photosensitizer, most commonly methyl-amino levulinate (MAL) or aminolevulinic acid (ALA), which is activated by light and produces a clinical effect such as tissue destruction. PDT is widely used in the treatment of cutaneous malignancies and psoriasis. In psoriatic lesions, it is thought that it may be toxic to keratinocytes and produce immunomodulatory effects.[13] PDT also has antibacterial effects.[14]

Previously, PDT using ALA, known as PDT-ALA, was studied and found to effectively treat acne vulgaris,[15] but this has only been shown to be the case in some subgroups. Application of ALA leads to an increase in protoporphyrin IX in hair follicles, selectively targeting the follicular epithelium.[16]

A study evaluating the efficacy of PDT-ALA in HS was conducted in which 4 patients underwent topical application of ALA to the treatment site for 4 hours followed by exposure to a diode laser or broadband red light for up to 3 treatment sessions.[16] At an 8-week follow-up visit, one patient's HS had clinically worsened and the other patient had only a slight improvement. Notably, one patient was not able to complete the study due to significant pain and burning and another patient dropped out after his HS worsened. The authors concluded that the treatment was ineffective at improving HS.[16] Two other studies had similar findings.[17,18]

In contrast, another study of PDT-ALA using blue light (407-420 nm) in 4 patients found significant clinical improvement in all patients without associated pain.[19] In this study, patients had 3 or 4 total treatments every 1 to 2 weeks and were followed for 3 months. ALA was applied for 15 to 30 minutes and the blue light was administered for 18 minutes. Of the 4 patients, 3 had no lesion recurrences after 3 years. Because of recurrence, 1 patient required additional PDT-ALA twice a year and had good response.[20] This study was small and did not use a validated measure to assess HS disease severity. In a larger study of 27 patients who underwent PDT with intralesional ALA using a diode laser, 21 patients had a good or complete response.[21] Patients with many interconnected sinus tracts required additional treatments. Axillary lesions responded best to therapy. Pain, erythema and swelling were notable side effects and no infections were reported.[21]

In another study by Schweiger et al, patients with many HS lesions in various anatomic locations underwent treatment once per week for 4 weeks. Topical ALA was applied for 45 minutes and subsequently irradiated with either a 417-nm blue light, a 415-nm blue light that was a light-emitting diode (LED), or IPL. Among 12 patients with HS, PDT-ALA was effective in reducing the number of lesions and improving Mean Global Severity scores; 25% of patients achieved complete resolution. Patients also experienced improved quality of life as assessed by the Dermatology Life Quality Index (DLQI). Notably, blue light sources were better tolerated than IPL. This study was not blinded, the sample size of 12 patients was small, and the follow-up period of 3 months was short.[22]

While ALA is a commonly used photosensitizer, another study used intralesional methylene blue and had promising results. A 635-nm LED lamp was used to activate the photosensitizer. Seven patients with Hurley stage II or III HS refractory to medical management were treated with 1 or 2 treatment sessions. There was a 15-minute incubation period with the methylene blue and each lesion was irradiated transcutaneously for 8 minutes with an LED lamp. Reduction in lesion diameter was used to assess treatment response. All patients achieved a good response or greater than a 75% reduction in lesion diameter. Patients with Hurley stage II HS responded better than those with stage III disease.[23]

Another PDT study using methylene blue was performed using a nisomal drug delivery system (NMB) to improve drug penetrance. Eleven patients with varying HS stage disease affecting the bilateral axillae, buttocks, inframammary and groin areas were treated with NMB on one side of their bodies while a non-nisomal methylene blue gel, termed FMB, was applied to the other sides as a control. The IPL device was used with a 630-nm filter and a fluence of 25 J/cm^2 and treatments were performed bi-monthly for up to 6 months. Clinical response was measured using the Hidradenitis Suppurativa Lesion, Area, and Severity Index (HS-LASI). While both treatments significantly improved the HS-LASI scores, the lesions treated with the NMB gel showed a significantly greater reduction in lesion size than the those treated with FMB. Patients with Hurley stage III disease had mixed outcomes.[24]

In contrast to surgical management and systemic therapies, PDT is less costly and invasive with minimal side effects (pain, erythema and discomfort during treatment).[25] The risk of scarring is low.[22] Treatment efficacy is often limited by the penetrance of the photosensitizer used. Overall, it is difficult to draw conclusions from existing studies of PDT due to their lack of standardized procedures and small sample sizes. The responses are variable and the authors' personal experiences with topical PDT have not been promising.

Carbon dioxide laser

Described in 1987 by Dalrymple and Monaghan, the carbon dioxide (CO_2) laser was the first laser used to treat HS (see Table for summary of laser therapies). The CO_2 laser emits light at 10,600 nm and can be used to deroof sinus tracts and excise or vaporize HS lesions. When used in its focused mode, the CO_2 laser ablates apocrine glands and vaporizes skin tissue to the subcutis, effectively removing sinus tracts.[31] Additionally, the CO_2 laser can be beneficial in preventing active lesions in patients with severe refractory disease.[31]

In the authors' experience, the continuous wave CO_2 laser with a spot size of 0.2 or 1 mm at a fluence of 55 W is optimal for treating HS.[5] Depending on the patient's pain tolerance, the procedure can be performed in an outpatient setting under local anesthesia, however, general anesthesia may be required.[31] In general, most patients can be treated in the outpatient setting, effectively decreasing expense and reducing the risk of general anesthesia.[32] Methylene blue can be used to identify difficult-to-probe sinus tracts and tracts with concealed openings, ensuring complete removal of epithelized tissue to prevent recurrence.[40]

Laser vaporization and excision

Several studies have evaluated laser vaporization and excision and found the technique to be effective with a low risk of recurrence. Dalrymple and Monaghan treated 6 patients with recurrent HS with 1 to 4 treatment sessions to vaporize problematic tissue and allowed healing by secondary intention. In treated areas, no disease recurrence was observed 9 months to 3 years after treatment.[28] Lapins et al also used a vaporization technique, utilizing the freehand laser mode set at 30 W in 24 patients with recurrent stage II HS. Rather than using the laser to cut tissue, they vaporized the tissue in layers. They followed patients for 15 to 47 months and only 2 patients had recurrence in the previously treated areas. Another 10 patients experienced recurrence in anatomic locations other than the treated areas, and 4 patients had recurrence in the same anatomic location, but >5 cm distance from the previously treated sites.[29]

Finley and Ratz studied the excision technique of the CO_2 laser using the continuous-wave mode in 7 patients with axillary or inguinal disease refractory to oral and intralesional medications. Treated lesions were allowed to heal by secondary intention. Healing took 4 to 11 weeks and all patients had subjectively good results. Only 1 patient had recurrence within the 10 to 27 month follow-up period, while 5 patients reported active disease in areas other than those that were treated.[30] Another study of 9 patients with refractory HS in the axilla, groin or both regions found that patients were highly satisfied with the treatment results. Patients were treated with a range of 1 to 5 treatment sessions. Five patients had procedures that required general anesthesia. The CO_2 laser was used to ablate apocrine glands while larger lesions were excised using the cutting mode. The treated area was either closed or left to heal by secondary intention. Seven of the 9 patients achieved good results, did not have recurrence 1 year after treatment, and were able to stop systemic medications.[31]

In a larger study, Hazen and Hazen evaluated CO_2 laser excision and marsupialization in 61 patients with advanced stage HS primarily affecting the axilla and groin. The CO_2 laser was used to excise tissue down to the deep dermis or subcutaneous fat, and then the area was probed for additional sinus tracts. Using the unfocused mode of the laser, the area was vaporized to produce a "pocket-like defect," termed *laser marsupialization*. Patients required different numbers of treatment sessions, ranging from 1 to 16 and they followed patients for as long as 17 years. The average disease-free period was about 4 years.[32]

Several factors have been found to impact CO_2 laser treatment outcomes. One study found that obese and African American patients tended to require more treatment sessions. Since the number of African American patients in the study was small, larger studies need to be done to confirm this observation.[32]

CO_2 laser therapy offers many advantages. There is minimal blood loss, allowing a clear view of the surgical field to identify and easily remove sinus tracts, thus facilitating complete removal of affected tissue.[32] While scar formation and contraction after the procedure has been observed, this risk may be lower than in other surgical methods.[28,29,31] In addition, associated pain is less than that of other surgical procedures.[28] Risk for postoperative infection and recurrence also appears to be lower following CO_2 laser excision than conventional surgery. However, definitive conclusions are difficult to draw, because the number of studies available regarding this method is limited compared to standard surgical interventions, thus allowing for significant bias due to operator technique.

Wound dehiscence, formation of hypertrophic granulation tissue, and postoperative cellulitis are potential complications.[31,32] Finley and Ratz noted minimal complications with the CO_2 excision technique, with only 1 patient having temporary paresthesias. While 1 patient did experience skin contracture in the setting of noncompliance with the recommended stretch exercises, the contracture resolved after resuming the suggested exercise regimen.[30]

A scanner-assisted CO_2 laser technique has also been described in the literature.[26] Using a rapid-beam microprocessed scanner system and an attached handpiece, the system performs spiral scans of the tissue, allowing a select round area of tissue to be ablated. Thirty-four patients with stage II HS were treated with this method. Four patients had recurrence in previously treated areas within the first 6 months after treatment, 12 patients had disease recurrence >5 cm from the treated area, and 25 patients experienced recurrence in a different anatomic location. These results suggest that additional treatment sessions may be necessary to prevent recurrence. The mean healing time was 4 weeks. Most patients reported subjective improvement in their condition after treatment. Another study of 58 patients used the scanner-assisted technique with a laser power ranging from 25 to 35 W.[27] Seventeen patients experienced disease recurrence after a mean follow-up period of 12.2 months, and most patients were satisfied with the treatment. Obesity was a risk factor for recurrence, suggesting that the treatment may be less effective in obese patients.[27]

In certain instances, the excision technique is more advantageous than the vaporization technique, particularly when pathological examination of the tissue is required or larger areas of tissue need to be removed.[26] Compared to the freehand vaporization technique, the scanner allows for more even and exact tissue ablation, but this technique is more time-consuming than using the laser in freehand mode[26] and may not be effective for deep lesions. In subsequent studies, the scanner has not been shown to improve long-term results. Madan et al suggested that this technique be used for localized disease with small lesions.[31]

Fractional carbon dioxide laser

Fractional CO_2 laser has been used to treat residual scarring in HS. One case report described a patient with inframammary and axillary HS lesions that were treated with the fractionated laser for 2 treatment sessions. At a 6-month follow-up visit, the patient reported no recurrence of lesions in the treated area and the patient was satisfied with the results.[33] In the authors' experience, this technique has not provided the same results for primary HS as CO_2 excision, but can be used for scar revision.

Another case report described a patient with stage III HS who failed oral systemic therapies but demonstrated partial improvement after neodymium-doped yttrium aluminum garnet (Nd:YAG) laser treatments. Despite this treatment, she still had sinus tracts and scarring, which were treated with CO_2 laser excision and left to heal by secondary intention. The patient experienced scar contracture and

TABLE Summary of Laser Therapies for HS

Source	Number of subjects	Dosing and treatment schedule	Results
Carbon dioxide laser excision			
Lapins et al[26]	34 patients	Hurley stage II patients were treated with the carbon dioxide laser rapid-beam optomechanical scanner system (20-30 W, spot size 3-6 mm).	4 patients experienced local recurrence during the mean follow-up period of 34.5 months. Patients healed on average in 4 weeks.
Mikkelsen et al[27]	58 patients	Patients treated with the carbon dioxide laser scanner system (20-35 W, spot size 4 mm) for 1 treatment session.	17 patients experienced local recurrence during the mean follow-up period of 20.6 months.
Dalrymple and Monaghan[28]	6 patients	Patients with recurrent disease treated with the Coherent System 400 carbon dioxide laser for 1 to 4 treatment sessions (depth of 3-8 mm, until all scarred areas were vaporized).	6 patients healed within 3 to 7 weeks and all were disease free when followed for 9 months to 3 years. Three patients had disease recurrence in new areas between 1 to 4 years after treatment.
Lapins et al[29]	24 patients	Recurrent Hurley stage II patients treated with Sharplan 1030 in freehand laser mode (30 W, spot size 2 mm) for 1 treatment session.	24 patients healed within 3 to 5 weeks. 8 patients had no recurrences. 2 patients experienced local recurrence. 4 patients had recurrence at areas adjacent to previously treated areas. 10 patients had recurrence in new untreated areas, after a mean follow-up period of 27 months.
Finley and Ratz[30]	7 patients, 12 treated sites	Patients were treated with carbon dioxide laser (40 W, spot size 0.1 mm, continuous-wave) for 1 treatment session.	Patients usually healed within 4 to 8 weeks. 1 patient had recurrence at the margin of a treated area after a follow-up period of 10 to 27 months. 5 patients had disease activity in new previously untreated areas.
Madan et al[31]	9 patients, 27 treated sites	Refractory HS patients treated with Sharplan 40 C carbon dioxide laser (25-40 W) for 1 to 5 treatment sessions.	7 patients did not have recurrence after one year. 1 patient had recurrence at the treated site 3 months after laser therapy. 2 patients had disease activity at areas adjacent to previously treated areas.
Hazen and Hazen[32]	61 patients, 185 treated sites	Patients were treated with the Sharplan carbon dioxide laser (8-30 W, spot size 0.22 mm) for 1 to 16 treatment sessions (average 2.5 sessions per patient).	Patients healed within an average of 8.8 weeks. 2 patients had disease recurrence at the margin of prior treated areas. Patients were disease-free for on average of 4 years (range 1-17 years).

Abbreviations: cm, centimeter; HS-LASI, hidradenitis suppurativa lesion, area, and severity index; J, joules; µm, micrometers; µs, microseconds; mJ, millijoules; mm, millimeters; ms, milliseconds; Nd:YAG, neodymium-doped yttrium aluminum garnet laser; nm, nanometers; W, watts.

ulcerations, which were subsequently treated with 4 fractional ablative CO_2 laser treatments every 5 to 6 weeks. After the last treatment, the patient experienced resolution of the ulcerations and improvement in the scar, which was present at a 16-month follow-up visit.[34]

Nd:YAG laser

As the pathogenesis of HS appears to involve follicular occlusion, several studies have evaluated lasers utilized for hair removal in the management of HS.[36] The Nd:YAG laser is primarily used as a laser hair removal device. It has a long wavelength of light, allowing it to penetrate deep into the dermis to target melanin in the hair bulb, effectively damaging hair follicles while limiting epidermal melanin absorption.[41] The laser may be beneficial for recurrent stage I and II HS.[5]

Early studies demonstrated the efficacy of the long-pulsed 1064-nm Nd:YAG laser in the treatment of dissecting cellulitis, a condition that is part of the follicular occlusion triad along with HS. The laser was associated with reduced purulence and lesional drainage. It also decreased patients' reliance on expensive systemic therapies and halted disease progression.[42]

Only a few studies have evaluated the use of the Nd:YAG laser for HS. Tierney et al studied 22 patients with stage II and III HS who had symmetric disease. One side of the body was treated with the long-pulsed 1064-nm Nd:YAG laser for 3 monthly treatment sessions as well as topical antimicrobials (clindamycin and benzoyl peroxide) while the other side was treated with topical antimicrobials only. They found a significant reduction in HS severity as measured by the HS-LASI score over all anatomic sites on the laser-treated site at the 3-month time point.[35] In a follow-up to the previous study, the patients were treated with their fourth monthly treatment session and then followed for 2 additional months. The combination of Nd:YAG and topical antimicrobials was found to be more effective at improving HS, particularly for axillary and inguinal lesions, than topical antimicrobials alone. In addition, most patients reported a decrease in pain associated with disease after laser treatment.[36] Xu et al performed another study using the long-pulsed 1064-nm Nd:YAG laser on patients with Hurley stage II disease in the groin and axillae. Two treatment sessions were performed with 1 month between sessions. Treatment outcomes were assessed using the modified HS-LASI

■ **TABLE Summary of Laser Therapies for HS (continued)**

Source	Number of subjects	Dosing and treatment schedule	Results
Fractional carbon dioxide laser for HS scarring			
Krakowski et al[33]	1 patient	Patient with residual scarring treated with micro-fractionated 10,600-nm carbon dioxide laser (15 mJ, single pass, pulse width of ~75 µs) for 2 treatment sessions with 2 months between sessions.	Improved appearance and no recurrence of inflammatory lesions 6 months after first laser treatment.
Nicholson et al[34]	1 patient	Patient with Hurley stage III HS with residual scarring treated with fractional carbon dioxide laser (50 J, 120 µm spot size) for 4 treatment sessions every 5 to 6 weeks.	Improvement in scar appearance and no recurrence after 16 months.
Nd:YAG laser			
Tierney et al[35]	22 patients, 33 treated sites	Patients with Hurley stage II and III HS treated with long-pulsed 1064-nm Nd:YAG laser (for skin types I-III: 40-50 J/cm^2, pulse duration of 20 ms, spot size 10 mm; skin types IV-VI: 25-35 J/cm^2, pulse duration of 35 ms, spot size 10 mm) on one side of the body with 3 monthly treatment sessions and topical antibiotics. The other side of the body was treated with topical antibiotics only.	When all anatomic sites were included, a significant improvement in the HS-LASI score (-65.3%) from baseline was found after 3 months at the sites treated with combination therapy but not at the sites treated with topical antibiotics alone.
Mahmoud et al[36]	22 patients, 34 treated sites	Patients with Hurley stage II HS treated with the long-pulsed 1064-nm Nd:YAG laser with the same parameters mentioned in the Tierney et al study. Patients followed for 4 monthly sessions. Both treatment and control sides were treated with topical clindamycin and benzoyl peroxide.	17 patients completed all treatment sessions. HS-LASI score (-72.7%) averaged over all sites was significantly improved on the side treated with the combination therapy 2 months after treatment.
Xu et al[37]	19 patients	Hurley stage II patients treated with long-pulsed 1064-nm Nd:YAG laser with the same parameters as Tierney et al for 2 monthly treatment sessions.	19 patients completed all treatment sessions. Modified HS-LASI score (-31.6%) averaged over all sites was significantly improved after the 2 treatments.
Long-pulsed Alexandrite laser			
Koch et al[38]	1 patient	Hurley stage II patient treated with long-pulsed 755-nm Alexandrite laser (15-22 J/cm^2, pulse duration 20 ms, spot size 15 mm) for 6 treatment sessions.	Excellent response after 10 months.
Diode laser			
Downs et al[39]	1 patient	Patient treated with the Smoothbeam 1450-nm diode laser (14 J/cm^2, pulse duration of 50 ms, spot size 6 mm) with a dynamic cooling device for 4 treatment sessions.	Partial objective improvement, with a reduction in redness and pain as well as some subjective improvement.

Abbreviations: cm, centimeter; HS-LASI, hidradenitis suppurativa lesion, area, and severity index; J, joules; µm, micrometers; µs, microseconds; mJ, millijoules; mm, millimeters; ms, milliseconds; Nd:YAG, neodymium-doped yttrium aluminum garnet laser; nm, nanometers; W, watts.

and there was a significant reduction in the average score of all the lesion sites 2 months after the first laser treatment. Based on pathological findings, they also found a reduction in inflammation around the hair follicles, and decreased scarring and fibrosis in the dermis after 2 months of treatment, which correlated with clinical treatment response.[37]

Lesion location appears to affect treatment outcomes. While axillary and inguinal treated lesions showed significant improvement with the Nd:YAG laser, inframammary lesions did not show a significantly different change from the lesions treated with topical antibiotics alone. This may be due to the differences in hair quality at the treated sites.[35,36] Advantages of Nd:YAG include a short healing time and reduced downtime after the procedure.[35] Compared to other lasers, the long-pulsed Nd:YAG laser is less likely to cause scarring, infection, or dyspigmentation.[42,43] In addition, its wavelength does not target melanin as effectively, making it safe to use for hair removal in patients with darker skin types.[44] The Nd:YAG laser may be particularly useful in patients who cannot use systemic antibiotic therapies such as those in renal failure. Nd:YAG laser treatment may be limited by existing scarring, which may inhibit the laser beam from penetrating deep enough to produce a clinical response.[36] This option should be limited to Hurley stage I and II and may be helpful in stabilizing disease progression.

Long-pulsed Alexandrite laser

The long-pulsed 755-nm Alexandrite was shown to be effective for hair removal, particularly in pilonidal disease where it was found to be more cost effective than surgical management.[45] It is not well studied in the treatment of HS, but for pilonidal disease it is recommended to repeat laser treatments until there is complete ablation of hair at the treatment site.[46]

To our knowledge, there is only one case report of an HS patient treated with this laser. A patient with stage II HS was treated with the long-pulsed 755-nm Alexandrite laser for 6 sessions, achieving an excellent response without any adverse events. However, the patient was only followed for 10 months and larger studies will be needed to demonstrate its efficacy.[38]

Diode laser

The 1450-nm diode laser was previously found to be an effective treatment for acne vulgaris, but its mechanism is not fully understood. Its wavelength allows it to penetrate into the dermis and cause mild thermal damage of sebaceous glands, while sparing the epidermis from injury. The light is primarily absorbed by water. The laser device also includes a dynamic cooling device (DCD) that utilizes cryogen spray cooling. Cryogen spray pulses are given before and after laser pulses. This cooling technique aims to prevent damage to the epidermis.[47]

The 1450-nm diode laser was evaluated in a female patient with bilateral axillary HS lesions with scarring, but no tract formation. She was given 4 laser treatments and partial improvement was noted. The time between treatment sessions was not reported. The authors speculated that the diode laser would not be beneficial in chronic and advanced HS with sinus tract formation and substantial scarring.[48] Due to the limited number of studies on the 1450-nm diode laser, it is difficult to draw conclusions about its efficacy.

Electrosurgery/radiofrequency

Electrosurgery employs the utilization of devices that generate heat by emitting energy in the radiofrequency range of the electromagnetic spectrum. One such device is the ThermaCool TC, which emits 6-megahertz (MHz) of alternating current and is able to heat the skin by using a unipolar radiofrequency system.[39] The skin is cooled using a cryogen system.[49] The use of a nonablative radiofrequency device was previously studied in the treatment of acne vulgaris and shown to be effective. It is thought that the heat produced may inhibit the function of sebaceous glands, decreasing sebum production.[50]

One case report in 2008 evaluated its efficacy in a patient with HS refractory to medical management that included topical and oral antibiotics, topical retinoids, oral isotretinoin and intralesional triamcinolone. While the patient had extensive disease with multiple sinus tracts and prominent scarring on his neck, back and bilateral axillae, his neck was the only area treated with a single pass using the nonablative radiofrequency device (setting: 61.5 to 63). The patient showed improvement at a 2-month follow-up visit with no new lesions on his lateral neck and a 50% reduction in new lesions on his posterior neck. Two more treatment sessions occurred 2 months and 4 months after the initial session that consisted of either 2 or 3 passes to both the lateral and posterior neck, after which, the patient did not require systemic therapies. The authors did not use an objective measure of clinical improvement, making it difficult to assess and compare the clinical outcome. The patient was not followed beyond 6 months so long-term effectiveness is not known.[39]

Another study used a 3.8-MHz unit along with a loop electrode to excise HS lesions, and found that 83% of patients had resolution of their treated lesions. Two patients in the study developed postoperative infections requiring antibiotics. Patients were not followed after treatment so long-term efficacy is not known.[51] This treatment option may be considered for earlier stage lesions. This technique produces a relatively small defect when compared to wide surgical excision, and wounds heal by secondary intention.[51] Additionally, there is no downtime after the procedure. However, as higher fluences may be necessary, topical or tumescent anesthesia may be required as the procedure can be painful.[39]

External beam radiation therapy

Radiation therapy was initially studied in HS patients over a half century ago, but only a few studies have evaluated its efficacy in HS,[52] which may be due to the risks associated with the procedure, including potential mutagenicity. Prior studies have demonstrated its effectiveness in treating refractory dissecting cellulitis.[53] While variable doses have been studied, it is recommended to use doses of 7.5 Gray (Gy) with 2.5 Gy per fraction.[54]

In the first large study treating HS, 231 patients were treated with different schedules for a total dose of 3 to 8 Gy. Eighty-nine patients (38.5%) had complete resolution of their lesions.[55]

There is a case report using radiation therapy to treat a woman with HS lesions located in the bilateral axillae, inguinal areas and perianal regions that were refractory to medical and surgical management. She was treated with a total dose of 450 centigray (cGy), with 150 cGy fractions over 2 days in all areas. In the left groin area, the lesions were persistent and an additional 600 cGy was given at 200 cGy per fraction. Following therapy, she had new lesions form on her thigh and in the perineal area and also had recurrent lesions in the groin, which were treated. After these additional treatments, she had resolution of her lesions with no recurrence for 2.5 years. It is important to note that she changed her diet and lost significant weight after her radiation therapy, which may have augmented treatment response.[54]

Patel et al evaluated the efficacy of radiation therapy in 13 treatment areas in 5 patients with HS stage II or III using a dose of 7.5 Gy that was given in 2.5 Gy fractions over successive days. Treatment response was assessed 2 months after therapy and was dependent on lesion location. Perineal lesions showed no subjective improvement, but all axillary lesions demonstrated at least partial improvement. The authors speculated that extensive scarring in the perineal area of these patients might have affected treatment outcomes. All patients received various treatments after radiation therapy, ranging from oral antibiotics to surgical excision and debridement.[56]

Advantages to radiation therapy include its lack of invasiveness compared to surgery with no acute side effects. However, there is concern about the potential mutagenicity of radiation therapy with increased risk of tumor induction so caution is advised and treatment area should be limited.[54] Furthermore, efficacy in Hurley stage III is questionable. There is also concern that HS may be triggered by external beam radiation. There is a recent case report of a woman developing stage II HS following radiation therapy for breast cancer. The dosage of radiation to treat breast cancer is 50 Gy, which is significantly higher than the dosage used to treat HS.[57]

Conclusions and future directions

Light- and laser-based management appears to be a promising treatment option for HS, however studies are currently limited. Further research is needed in order to elucidate the mechanism of action and to further define the efficacy in the various subtypes and stages. The severity of disease, location of involvement, side effects of the laser, and medical comorbidities should be taken into account when deciding the type of laser to use in HS. The Nd:YAG laser, IPL, diode lasers, and PDT offer noninvasive treatment options with few side effects and little downtime. While the CO_2 laser is more invasive and requires additional recovery, it can still be performed on an outpatient basis and improves visualization of the boundaries of involvement. For advanced disease with scarring, the CO_2 laser offers the best results of the energy-based devices. Often, a combination of therapies can be used to successfully treat HS. Advancements in laser technology will likely continue to impact HS management and improve patient outcomes.

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