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Case Report **OPEN ACCESS**

Post-laser hair removal folliculitis: A case report

Jakkrit Juhong [1], Weeratian Tawanwongsri [2,3]*

[1] Department of Ophthalmology, School of Medicine, Walailak University, Nakhon Si Thammarat, THAILAND
[2] Division of Dermatology, Department of Internal Medicine, School of Medicine, Walailak University, Nakhon Si Thammarat, THAILAND
[3] Center of Excellence in Data Science and Health Study, Walailak University, Nakhon Si Thammarat, THAILAND
***Corresponding Author:** weeratian.ta@gmail.com

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ABSTRACT

Depilation through laser hair removal has gained popularity due to its long-lasting effects, which can last for several months and, in some cases, be considered permanent. This method also improves quality of life. However, common complications include blistering, pigmentary changes, and scabbing. Folliculitis is rare, with most cases being mild and transient. We hereby report on a 33-year-old healthy Thai male who rapidly developed severe folliculitis one day after undergoing diode laser treatment, which combined three wavelengths (755 nm, 810 nm, and 1,064 nm) into a single pulse. The condition improved significantly following a short course of prednisolone and topical benzoyl peroxide. At the 4-week follow-up, the lesions had nearly resolved, with only a few erythematous papules and hyperpigmented follicular macules remaining and no scarring. Further studies are needed to clarify the mechanism of folliculitis after hair removal laser treatment, enabling more effective prevention and management for patients.

Keywords: folliculitis, lasers, hair removal, adverse effects

INTRODUCTION

Laser hair removal has become a widely chosen method for eliminating unwanted hair. It offers a long-lasting hair-free period by targeting and destroying the germinative cells in the hair follicle bulge [1]. Given its long-lasting effects, which can span several months and may be considered permanent, laser hair removal has been shown to significantly improve patients' quality of life [2, 3]. Photo-epilation uses thermal energy directed at the melanin-rich hair shaft and hair bulb matrix. This method destroys the surrounding follicle structures by targeting the follicular stem cells in the outer root sheath. The damage is achieved through photothermal, photomechanical, and photochemical injuries [1, 4]. The most effective lasers for photo-epilation have wavelengths between 600 and 1,100 nm. This range allows for selective absorption by melanin and deeper penetration into the skin. Light sources that destroy hair through photothermal effects include the alexandrite laser (755 nm), diode lasers (800 or 810 nm), neodymium-doped yttrium aluminum garnet laser (Nd:YAG) laser (1,064 nm), and intense pulsed light devices [5].

A frequentist treatment ranking method with p-scores to assess the efficacy of various hair removal interventions was utilized [6]. After approximately six months, all these four treatments demonstrated a significant reduction in absolute hair count. The Alexandrite laser was identified as the most effective based on the p-score, followed by the diode laser. Despite its benefits, treatment can cause various cutaneous complications, including pain, burns, folliculitis, leukotrichia, paradoxical hypertrichosis, pigmentary changes, changes in nevi, pili bigeminy, herpes infections, thrombophlebitis, scar, hyperhidrosis, bromhidrosis, Fox-Fordyce disease, and frostbite from the cooling system [7, 8]. Folliculitis, although listed among complications, is relatively rare. The incidence of post-laser hair removal folliculitis is 6.4%, with the majority of cases being mild and transient [7]. We reported a rare case of severe folliculitis following hair removal laser treatment.

CASE PRESENTATION

A 33-year-old healthy Thai male visited our dermatology clinic presenting with multiple pruritic erythematous papules and pustules localized to the anterior neck area following his first laser hair removal session at another private clinic. One day prior to the visit, the patient underwent hair removal using a diode laser (Coolite Bolt, China), although he could not recall the specific parameters used. The caregiver who performed the laser therapy informed him that she used high fluence to achieve better outcomes. The laser combines three wavelengths–755 nm, 810 nm, and 1,064 nm–into a single pulse. During the treatment, the patient reported a pain score of 6 out of 10, which improved after the application of cool air to the affected area. Immediate hair depilation was noted upon gentle wiping of a small, treated area. Post-treatment, his pain score decreased to 2 out of 10, and he described a warm sensation over the treated area. No medication was prescribed after the procedure.

Within the first 24 hours, a widespread eruption of pruritic erythematous papules and pustules developed across the treated area, without blistering or hypo- or

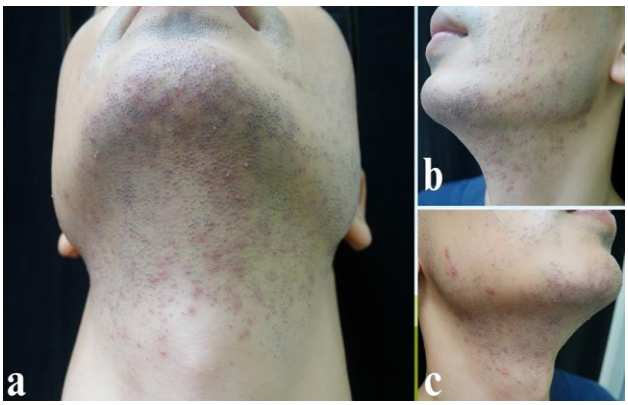

Figure 1. Dermatologic examination of the neck and jawline: (a) anterior neck view showing multiple follicular painful erythematous papules and pustules with intact hair, (b) left lateral side of the neck and jawline, & (c) right lateral side of the neck and jawline (reprinted with permission of patient)

hyperpigmentation. He denied any comorbidities, new drug intake or new topical medications, exposure to heated water, or exposure to contaminated water. He noted that erythematous papules on his jawline often developed after shaving, but he had not previously experienced pustules. His last shave was two weeks prior. He regularly uses sunscreen and vitamin C serum in the morning, 0.05% retinol serum before bedtime, and had no prior history of laser treatment on his face or anterior neck. He attended routine annual check-ups, no significant comorbidities were identified, and he was not taking any systemic medications. On examination, vital signs showed blood pressure of 120/80 mmHg, a pulse rate of 75 beats per minute, a respiratory rate of 18 breaths per minute, and a body temperature of 37.0 °C. Dermatologic examination revealed multiple follicular painful erythematous papules and pustules with intact hair on the anterior neck and jawline (**Figure 1**). No pili multi-gemini hair was observed during the dermoscopic examination. He had Fitzpatrick skin type IV. The remainder of the examination was normal. The pus was collected using a 21G needle and stained with Gram stain and potassium hydroxide (KOH). The results showed numerous neutrophils without any organisms.

After the diagnosis of post-laser hair removal folliculitis was made, the patient was prescribed prednisolone 30 mg per day for 5 days, followed by a taper to 20 mg per day for another 5 days. Additionally, 2.5% benzoyl peroxide was prescribed to be applied to the affected area for 5 minutes before rinsing off, twice daily. At the 2-week follow-up, the lesions had resolved by approximately 60 percent. At the 4-week follow-up, the lesions had nearly resolved, with only about 10 percent remaining as small red papules and a few brownish spots around hair follicles, without any scarring (**Figure 2**).

Figure 2. Follow-up dermatologic examination at 4 weeks: (a) anterior neck view, (b) left lateral side of the neck and jawline, & (c) right lateral side of the neck and jawline (reprinted with permission of patient)

DISCUSSION

While laser hair removal is generally perceived to be effective, it is important to consider potential complications. Here, we report a rare case of severe folliculitis following diode laser hair removal treatment in a young Thai male with Fitzpatrick skin type IV. The temporal correlation, with the abrupt onset of the cutaneous lesion after laser therapy, the absence of recent introduction of new medications, and the resolution without systemic antibiotics, supports the diagnosis of laser-induced folliculitis.

According to reported side effects from diode laser use, eight patients with Fitzpatrick skin types V and VI using an 810-nm diode laser for facial hair removal was studied [9]. All patients experienced mild perifollicular erythema and minimal edema, lasting about 24 hours. Two patients had blistering and crusting, resolving within days to 4-8 weeks. Three patients developed hyperpigmentation, which cleared in 2-4 months with 4% hydroquinone lotion. It was conducted a study on the use of a pulsed 940 nm diode laser system for treating unwanted body hair on the legs [10]. The study involved thirty healthy female Asian participants aged 18-48 years with Fitzpatrick skin types IV and V. Three patients experienced transient adverse events, including crusting, folliculitis, and blisters. But no residual scarring or permanent skin discoloration was observed at the 8-month follow-up. A multicenter study on hair removal using an 810-nm diode laser with 368 patients (phototypes III to V) was carried out [11]. Most experienced transient erythema and perifollicular edema. Pseudofolliculitis occurred mainly in perineum. First-degree burns were reported in nine areas, and second-degree burns in three. Hyperpigmentation was seen in two cases, and hypo-pigmentation in ten. Short-term adverse effects occurred in 0.7% of 1,840 sessions. No long-term adverse effects were observed six months post-treatment. It was evaluated the safety of a triple wavelength diode laser module (755, 810, and 1,064 nm) for hair removal across all skin types (Fitzpatrick I-VI) [12]. The final analysis included thirty participants, focusing on the axilla and bikini line. Treatment parameters were a fluence range of 3-9 J/cm^2, accumulated energy of 6-15 kJ, and a pulse repetition rate of 9-10 Hz. No serious adverse events were recorded. Anticipated adverse events were transient and resolved without intervention.

When selecting laser types and parameters, the key considerations are skin and hair color. In this instance, the patient had dark skin and hair. Fitzpatrick skin types IV to VI have increased amounts of epidermal melanin, which interferes with the melanin in the hair bulb and shaft. This interference results in a higher frequency of adverse effects. Consequently, the appropriate laser parameters for such cases include a long wavelength and a long pulse duration [13]. The Nd:YAG laser is considered the most effective system for treating pigmented skin. Its longer wavelength acts as a protective factor against thermal damage to the epidermal melanin, allowing for the use of higher fluences to achieve better clinical outcomes with mild transient adverse events

such as erythema, perifollicular edema, blistering, and dyspigmentation [1, 14]. Another safety recommendation to prevent folliculitis is to use optimal cooling and fluence and avoid multiple passes [7].

In diode laser treatments, pulse durations range from 5 to 500 ms. For treatments requiring longer pulse durations (greater than 10 ms), contact cooling is highly effective, typically using Sapphire tip cooling [15]. This method provides consistent cooling throughout the procedure–before, during, and after. The tip temperature is maintained at 4 °C before the shot, drops to 0 °C during the shot, and returns to 4 °C once the shots are complete. The optimal skin surface temperature for laser hair removal ranges from 42 °C to 47 °C. To achieve effective cooling, the cooling plate temperatures are maintained between -5 °C and 0 °C. This prevents blistering, which is more likely to occur if the skin surface temperature exceeds 50 °C. The epidermis remains protected as long as its temperature does not rise above the threshold for denaturation, which is between 60 °C and 65 °C [16]. The occurrence of protein denaturation and the loss of plasma membrane integrity depend on the duration and temperature of exposure. For instance, a full-thickness burn can occur at 69 °C with just 1 second of exposure, or at 60 °C for 10 seconds [17]. According to the optimal fluence for treatment, it is the highest fluence that can be tolerated without causing any adverse effects while still achieving the desired endpoint [18]. The appropriate clinical endpoint includes the presence of perifollicular erythema and edema [13]. It was shown that various fluences of diode laser for hair removal in patients with Fitzpatrick skin types IV to VI ranged from 5 to 50 J/cm² [14]. The study also noted that folliculitis developed in 3 out of 30 cases when using relatively high fluences between 44 and 50 J/cm² [10]. Recently, it was shown the effectiveness and safety of a diode laser module that combines three wavelengths (755, 810, and 1,064 nm) in a single pulse for participants with Fitzpatrick skin types I to VI, similar to the device used in our case [12]. The parameters were as follows: spot size 2-4 cm², pulse width 3-220 ms, and frequency 10 Hz. The fluence varied based on skin type: 7-8 J/cm² and 13-14 kJ total energy for skin types I-III, and 4-6 J/cm² and 12-14 kJ total energy for skin types IV-VI. The cooling device used was Sapphire tip cooling at 4 °C. Significant hair reduction was observed at the 3-month follow-up, with no serious adverse events recorded. Adverse effects were transient and resolved without intervention, suggesting that using moderate fluences can effectively achieve hair reduction without severe adverse reactions. Based on our case involving an individual with dark skin (Fitzpatrick skin type IV) and dark hair, we recommend avoiding multiple passes and using a long-wavelength laser, preferably 1064 nm, with a pulse duration of 10-20 ms, an average fluence of approximately 4-6 J/cm², and optimal cooling to maintain the skin surface temperature below 50 °C. These measures are intended to minimize the risk of post-diode laser hair removal folliculitis. The parameters should be adjusted based on the treatment outcome and any adverse reactions in each individual patient.

The mechanism behind folliculitis after hair removal therapy is not well understood. It was suggested it resembles pseudofolliculitis barbae [19]. Laser hair removal destroys the hair follicle through photo thermolysis, leading to the expulsion of the residual hair shaft through the skin. This can result in an inflammatory foreign-body reaction, similar to pseudofolliculitis barbae, which is caused by the intrafollicular or trans follicular penetration of tightly curled, coarse hair [20, 21]. Once the depilatory effect has finished, the source of the foreign body response is eliminated, leading to the resolution of folliculitis. This proposed mechanism corresponds with previous histologic studies. The structure of the hair follicle changes immediately after 810 nm diode laser hair removal [22]. The space inside the hair follicle enlarges, accompanied by vacuolation. The hair structure degenerates, appearing as a basophilic mass when stained with hematoxylin and eosin. Additionally, the polarity of the hair follicle cells is significantly disturbed. The basal membrane of the outer root sheath is disrupted in some areas, and the dermal tissue surrounding the hair follicle becomes edematous. Higher fluences resulted in full-thickness epidermal damage and residual thermal damage in the dermis [23]. As this reaction takes a few days to weeks to develop the foreign body reactions [24], it was reported a case where numerous itchy, red papules and pustules appeared approximately one week after laser hair removal [19]. In contrast, our case presented a widespread eruption of itchy, red papules and pustules across the treated area within 24 hours. We hypothesized that the mechanism of folliculitis in our case might be better explained by an alternative cause. The patient reported that the fluence was high, causing moderate to severe pain. When the laser light is absorbed by the melanin in the hair shaft, the generated heat is conducted to the surrounding follicular structures, resulting in significant damage to the follicle. We hypothesize that this may cause mild-to-moderate burns to the follicular epithelium. After a thermal injury, denudation and sloughing of the epidermis occur, followed by inflammation in the dermis, including neutrophilic and lymphocytic infiltrates [25]. The pathological process develops rapidly after the injury, occurring within the first hour and causing both edema formation and neutrophil infiltration [26, 27]. Neutrophils, the first immune cells to migrate to a wound, rely heavily on IL-8, which is released by epithelial cells, endothelial cells, and macrophages [28]. This aligns with our microscopic findings, where we observed numerous neutrophils without organisms in the Gram stain of the patient's pus. However, we recognize the need for further studies to clarify the mechanisms behind folliculitis following hair removal laser treatment. Additionally, clinical cohort studies are essential to better understand the incidence and risk factors associated with this relatively rare side effect. These efforts will enable us to provide more effective prevention and accurate management for our patients.

CONCLUSIONS

Laser hair removal is a common procedure for eliminating unwanted hair. Despite the well-documented effectiveness of this method, selecting the appropriate laser type based on the patient's hair and skin type, along with considering laser parameters and preventive methods, is crucial to avoid related adverse reactions. In cases of folliculitis, preventive methods include using optimal cooling and fluence and avoiding multiple passes. However, the pathophysiology of post-laser hair removal folliculitis is not well-established. Further studies are needed to provide comprehensive prevention and management strategies.

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Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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