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Role of pulsed-dye laser in the treatment for inflammatory acne vulgaris

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Abstract

Introduction: Acne vulgaris is one of the most common dermatologic conditions but the increase of bacterial resistances, adverse effects, and lack of response to usual therapies have led to investigate new therapeutic alternatives for acne. More recently, pulsed dye laser therapy is reported to reduce acne lesion counts and the possible additional benefit of simultaneously treating acne scarring make this therapy attractive.

Materials and methods: A prospective clinical trial was done to find out the role of pulse dye laser in the treatment of inflammatory acne vulgaris. The study was carried out with 60 patients with mild to moderate acne vulgaris and patients were undergoing the pulsed dye laser treatment at baseline and 4 weeks, 8 weeks and 12 weeks later.

Results: Among sixty patients with inflammatory acne, regarding the number of inflammatory lesions, the baseline mean number (± SD) was 12.77 ± 4.01; after 4 weeks of treatment 7.80 ± 4.11; after 8 weeks of treatment, 6.10 ± 4.03 and after 12 weeks of treatment was 4.17 ± 4.02. After 8 weeks of treatment by pulse dye laser, the level of improvement was excellent was 13.3%, good was 46.7%, the fair was 30% and poor 10% and after 12 weeks of treatment, excellent was 56.7%, good 13.3%, fair 23.3% and poor 6.7%. Regarding safety level, out of 60 patients of inflammatory acne vulgaris treated by pulsed dye laser, about 52(86.7%) patients did not observe any side effects.

Conclusions: On the basis of the study results, it can be concluded that Pulsed-dye laser is highly effective and well tolerated by patients in the treatment of inflammatory acne.

Keywords: Pulsed-Dye Laser; inflammatory Acne; Acne vulgaris; Laser treatment for Acne.

1. Introduction

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous unit affecting more than 85% of adolescents.[1] The pathogenesis of acne appears to be multifactorial. Acne vulgaris is an exceedingly common skin disorder that carries the potential for significant psychosocial morbidity.[1-3] The formation of actual inflammatory acne lesions appears to depend on the proliferation of *Propionibacterium acnes* (*P. acnes*) bacteria in the microcomedones and the metabolization of trapped sebum into proinflammatory free fatty acids. The treatment of mild acne includes various topical antimicrobials, retinoids, and keratolytics used alone or in combination. These topical modalities require frequent application by the patient and may result in clinically significant skin irritation. Moderate inflammatory acne requires the long-term use of oral antibiotics, which may be associated with increased bacterial resistance. Many patients require continuous treatment with topical and oral medications for months or years, and compliance with treatment often becomes a major issue.[2,3] Conventional therapy with antibiotics and retinoids yield mixed results and

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can be complicated by antibiotic resistance and adverse treatment profiles. Therefore, newer therapeutic modalities such as light-based therapy have been developed to address the need for acne treatment.[1]

Laser-based treatment options are appropriate alternative for treating acne patients in recent years who have not responded to previous treatments or in whom systemic treatment is contraindicated. Laser appears to reduce inflammatory acne by targeting some of the main pathophysiologic factors such as *P. acnes* bacteria, sebaceous gland activity, and by reducing inflammation. However, laser and light sources do not appear to be very effective for the treatment of noninflammatory comedonal acne.[4,5] More recently, it has been postulated that light-based therapies work to decrease *Propionibacterium acnes* level and reduce pilo sebaceous unit size and function.[6] Specifically, absorption of light of specific wavelength by endogenous porphyrins contained in *Propionibacterium acnes* is believed to produce phototoxic effects that kill the bacteria.[7,8] Light absorption leads to photo-excitation of porphyrins and subsequent release of singlet oxygen and reactive free radicals that exert bactericidal effects on *P. acnes*.[9,10] Besides reduction of the inflammatory component of acne, laser stimulates the immune response, and flattens the acne scars.[2] With pulsed dye laser light, it is possible to target the inflammatory component of acne by using hemoglobin as a chromophore.[11]

This laser source seems not only to eliminate bacteria directly but also through stimulation of the immune system. On the other hand, the low fluence also induces the production of procollagen secondary to heating of the perivascular dermis, a process that may be help reduce scarring associated with acne.[12,13] Moreover, few adverse reactions have been associated with use of pulsed dye laser light.[14] The most recent studies of the molecular mechanisms implicated in treating acne with laser light have reported an increase in the levels of transforming growth factor β1(TGF-β1) 24 hours after application of pulsed dye laser light at 595 nm (with a NliteV laser). TGF-β1 is known to be a potent inducer of collagen synthesis and plays a central role in initiating wound healing. It is also an essential immunosuppressive cytokine that promotes the termination of inflammatory processes. In addition, it is the most potent known inhibitor of keratinocyte proliferation.[2,15]

2. Materials and Methods

A prospective clinical trial was done in the department of Dermatology and Venereology, Combined Military Hospital (CMH), Dhaka for a period of July 2019 to December 2020. We recruited 60 adults with mild-to-moderate facial inflammatory acne. Consequitive type of non-probability sampling method was followed. Inclusion criteria included age of 13 years or older, general good health, willingness to participate and ability to comply with the requirements of the protocol, and the presence of clinically evident facial acne. Patients presenting with acne so mild that a clinical effect of the laser therapy, if present, would be difficult to demonstrate were excluded. Potential participants were also excluded for a history of oral retinoid use within 1 year of study entry, other systemic or topical acne therapies within 1 month, alpha hydroxy acid or glycolic acid use within 1 month, or microdermabrasion to the face within 3 months. Exclusion criteria were age of 12 years or younger and a history of prior dermabrasion or laser resurfacing of the face. In addition, pregnant women and lactating mother and individuals were excluded for the use of non-steroidal anti-inflammatory medications within 10 days prior to or for 2 weeks following the laser treatments provided in this study.

Patients were undergoing the pulsed dye laser treatment at baseline and 4 weeks, 8 weeks and 12 weeks later. Pulsed dye laser treatments were performed using the following laser parameters: wavelength of 595 nm, pulse duration of 3 μsec, spot size of 10 mm, and fluence of 4.5 J/cm^2. Primary outcome measures were acne severity after 4, 8 and after 12 weeks and adverse events at any time. Secondary measures were change in lesion counts after 4,8 and 12 weeks and change in acne severity with time. Participants were clinically assessed every other week for a total of 12 weeks, including the baseline visit during which the pulsed dye laser treatment was administered. Evaluation visits included lesion counts of papules, pustules, cysts, and erythematous macules (as representative of resolving previously inflammatory lesions). Because oxygenated hemoglobin is a chromophore for pulsed dye lasers, we hypothesized that absorption of the laser light by inactive, resolving acne lesions (termed *red macules*) might hasten the resolution of these troublesome lesional remnants. All lesion counts were performed at baseline and at weeks 4, 8, and 12.

Prior to the commencement of this study, the aims and objectives of the study along with its procedure, alternative methods, risks and benefits of this study were explained to the patients in easily understandable local language and then informed written consent were taken from each patient. It was assured that all information and records would be kept confidential. The patients were explained that they had the right to refuse or accept to participate in the study and they would not receive financial benefit from this study. Data were collected by face to face interview and were recorded in a questionnaire. Information was collected by taking medical history and clinical examination. Baseline laboratory investigations were carried out for purpose of exclusion and monitoring of side effects. Laboratory investigations included complete blood counts, liver function tests, serum creatinine, random blood sugar level, and serum cholesterol and triglyceride level. A four point scale is used to measure the level of response to treatment, if>75% clear- Excellent

response; if 50-75% clear- good response if 25-50% clear fair response; if <25% clear poor response. Safety and tolerability were assessed through evaluations of local facial tolerability and adverse events.

3. Results

A prospective clinical trial was done to find out the role of pulsed dye laser in the treatment of inflammatory acne vulgaris. Among 60 patients of inflammatory acne, 42(70%) was in the age group of less than 20 years and 18(30%) was more than 20 years age group and 36(60%) was female (Table 1). Regarding number of the inflammatory lesions, on the baseline mean number (± SD) was 12.77 ± 4.01; after 4 weeks of treatment of inflammatory acne by pulse dye laser 7.80 ± 4.11; after 8 weeks of treatment 6.10 ± 4.03 and after 12 weeks of treatment 4.17 ± 4.02(Table 2).After 4 weeks of treatment by pulsed dye laser, level of improvement was excellent 3.3%, good 10%, fair 60% and poor 26.7%; after 8 weeks of treatment, excellent was 13.3%, good was 46.7%, fair was 30% and poor 10% and after 12 weeks of treatment, excellent was 56.7%, good 13.3%, fair 23.3% and poor 6.7%(Table 3). Regarding safety level, out of 60 patients of inflammatory acne vulgaris treated by pulsed dye laser, about 52(86.7%) patients did not observed any side effects(Table 4).Among the 8(13.3) patients of inflammatory acne vulgaris treated by pulsed dye laser, 4(6.7) patients showed bruise, 2(3.3) patients showed irritation and each of the 1(1.6) patients showed burning sensation &erythema (Table 5).

Table 1 Demographic characteristics of patients (n=60)

Age in years	**Number (%)**
< 20 years	42(70%)
≥ 20 years	18(30%)
Gender	
Male	24(40%)
Female	36(60%)

Table 2 Distribution of the patients by number of the inflammatory lesions (n=60)

Number of the inflammatory lesions.	**Mean ± SD**
Baseline	12.77 ± 4.01
After 4 weeks	7.80 ± 4.11
After 8 weeks	6.10 ± 4.03
After 12 weeks	4.17 ± 4.02

Table 3 Distribution of the patients by level of improvement (n=60)

After 4 weeks	**After 8 weeks**	**After 12 weeks**
Excellent 2(3.3)	Excellent 8(13.3)	Excellent 34(56.7)
Good 6(10.0)	Good 28(46.7)	Good 8(13.3)
Fair 36(60.0)	Fair 18(30.0)	Fair 14(23.3)
Poor 16(26.7)	Poor 6(10.0)	Poor 4 (6.7)

Table 4 Distribution of the patients by level of safety (n=60)

Safety	Number (%)
With side effects	8(13.3)
Without side effects	52(86.7%)

Table 5 Distribution of the patients by level of side effects (n=8)

Side effects	Number (%)
Bruise	4 (6.7)
Irritation	2 (3.3)
Burning sensation	1 (1.6)
Erythema	1 (1.6)

4. Discussion

A prospective clinical trial was done in the department of Dermatology and Venereology, Combined Military Hospital (CMH), Dhaka with 60 patients with inflammatory acne vulgaris, those were treated with pulsed dye laser therapy. After 12 weeks of treatment by pulsed dye laser, level of improvement was excellent 56.7%, good 13.3%, fair 23.3% and poor 6.7% and regarding safety level, about 52(86.7%) patients did not observe any side effects. Our study findings have similarity with other studies of Orringeret al, Erceget al, Alster et al, Seaton et al, Jasimet al and Lehetaet al. One hundred seventy-five individuals were evaluated for eligibility. Of these, 24 males and 36 females with a mean age of 20.7 years (range, 13-31 years) and clinically evident acne vulgaris on the face met inclusion criteria and were enrolled. Nineteen participants were randomized to receive treatment to the left side of the face and 21 to the right side. Among all patients who were randomized to receive only 1 treatment, 14 of 20 completed the study. Of the 20 patients randomized to receive 2 laser treatment sessions, 12 of 20 completed the study. When comparing patients randomized to receive either 1 or 2 laser treatment sessions, no statistically significant differences in efficacy at any time point or for any subtype of acne lesion was demonstrated. A separate analysis of the time course within each treatment group by analysis of variance revealed that papule count was the only clinical end point to show a significant reduction in number of lesions compared with baseline levels on the treated side of the face. Laser therapy was generally well tolerated with 7 (18%) of 38 patients requiring minor reductions in the fluences delivered due to discomfort during the treatments. The only treatment-related adverse events were a single episode of postinflammatory hyperpigmentation (occurring in a patient with Fitzpatrick type VI skin) and 2 episodes of minimal focal bruising. In all other patients, the immediate clinical response to the laser treatment consisted of transient (approximately <2 seconds) cutaneous cyanosis followed in some cases by minimal to mild erythema that resolved within minutes or a few hours. A treatment lasted approximately 10 to 12 minutes to perform and an average of 385 pulses were delivered per treatment. [4]

A systematic review of PDL treatment for inflammatory conditions revealed nine studies on PDL treatment for acne with evidence that PDL may be an effective treatment for acne.[16] PDL has also been used for the treatment of hypertrophic facial acne scars. [17] PDL was thought to act by reducing *P. acnes* or sebaceous gland activity. However, Seaton *et al.* found that the efficacy of this laser is likely through its local anti-inflammatory effects via upregulation of TGF-β.[3] In another study, Seaton *et al.* examined the utility of PDL for inflammatory acne in a randomized controlled trial involving 41 adults. [2] At week 12, the average total lesion count fell by 53% in patients treated with the PDL compared with 9% in the control group. Similarly, the inflammatory lesion counts fell by 49% in PDL-treated patients compared with 10% in control group. In a smaller split-face study comparing PDL with untreated control in 10 patients, single treatment of PDL resulted in visible therapeutic improvement in 50% of patients at six weeks post-treatment, although two patients had worsening of acne.[18] A limited number of studies examined PDL compared with or in combination with conventional acne therapy. In another study, a group of 15 patients were treated with PDL and compared with 15 patients who received topical treatments (topical vitamin A acid, benzoyl peroxide) and another 15 patients who received chemical peels (trichloroacetic acid 25%). Improvement of acne lesions was noted in all three groups with no significant difference in improvement between the three treatment protocols. However, PDL was associated with higher remission in the follow-up period. [19]

5. Conclusion

On the basis of the study results, it can be concluded that Pulsed-dye laser is highly effective and well tolerated by patients in the treatment of inflammatory acne vulgaris. Further controlled randomized trial involving multicenter and large sample size should be carried out to draw conclusion.

Compliance with ethical standards

Disclosure of conflict of interest

All authors of the manuscript have no conflict of interests to declare.

Statement of ethical approval

This study was approved by Institutional Review Board (IRB), Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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