

A Case Series: A Successful of Alternative Modality with Red Light Low Level Laser Therapy for Acne Vulgaris

Rudi Chandra^{1*}, Nelva K. Jusuf¹, Khairina Nasution¹
¹Department of Dermatology & Venereology, Universitas Sumatera Utara,
Universitas Sumatera Utara Hospital, Medan
*Corresponding auhtor

Keywords: Acne vulgaris, low level laser therapy, red light

Abstract: Introduction: acne vulgaris is a chronic inflammatory disease of pilosebaceous units where the key factors of pathogenesis including follicular hyperkeratinization, microbial colonization of *Propionibacterium acnes*, increase sebum production, and complex inflammatory mechanisms. Low level laser therapy (LLLT) has been proposed as an alternative therapeutic modality to treat acne vulgaris with less side effects compared to other treatment options. Case: 22-yo man and 28-yo woman, who were suffering from moderate acne vulgaris, treated with red light LLLT (655 nm, <5mW CW, 57 mrad) twice a week, interval 3 days, and 3 minutes duration per treatment area. Follow up was taken for 4 weeks by lesions count and photographs. Both patients got significant lesions reduction, with final total reduction after 8 sessions in 4 weeks for both patients were 63,3% and 74%, respectively. Final reductions of inflammatory lesions in both patients were 69,7% and 75,9%, respectively. And final reduction of non-inflammatory lesions (comedones) in both patients were 56% and 70,6%, respectively. Discussion: Red light LLLT plays roles in the pathogenesis of acne, through its mechanism of actions in interfere sebum secretion of sebaceous glands, change keratinocytes behaviors, modulate cytokines to reduce inflammations, and suppressing microbial colonization of *Propionibacterium acnes*. Conclusion: Red light LLLT was effective as an alternative modality in reducing both non-inflammatory and inflammatory type lesions in acne vulgaris. The mechanism of actions of LLLT as the treatment of acne vulgaris are through its roles in the pathogenesis of acne.

1 INTRODUCTION

Acne vulgaris is a chronic inflammatory disease of the pilosebaceous units. Acne vulgaris is the most common skin disorder, affects virtually all individuals at least once. Incidence peaks in 18-years-old, but substantial numbers of 20- to 40-years-old also develop the disease and observed equally in both genders (Aydemir et al, 2014). Acne vulgaris is characterized by skin with scaly red skin (seborrhea), comedones, papules, nodules, pimples and scarring. Acne affects skin having dense sebaceous follicles in areas including face, chest and back. Acne may be of inflammatory or non-inflammatory forms (Suva et al, 2014).

Acne is a complex disease with multifactorial pathogenesis and considerable variation in severity. Key factors in the pathogenesis of acne including follicular hyperkeratinization, microbial colonization

of *Propionibacterium acnes* (*P. acnes*), increase sebum production, and complex inflammatory mechanisms (Zaenglein et al, 2016). Various modalities had been proposed for the treatment of acne, where most modalities work by counteracting microcomedones formation, sebum production, *Propionibacterium acnes*, and inflammation. Unfortunately these currently available treatment options, still show an inadequate response in several patients, while others suffer from actual adverse effects (Zaenglein et al, 2012).

Low level laser therapy (LLLT) has been proposed as an alternative therapeutic modality to treat acne vulgaris with less side effects compared to other treatment options (Avci et al, 2013). LLLT uses either coherent light sources (lasers) or non-coherent light sources consisting of filtered lamps or light-emitting diodes (LED) or, on occasion, a combination of both. The mechanism of action of

LLLT for acne is through the absorption of light (specifically blue light) by porphyrins that have been produced by *P. acnes* as a part of its normal metabolism, that act as endogenous photosensitizers, and causes a photochemical reaction and forms reactive free radicals and singlet oxygen species, which in turn lead to bacterial destruction. Red light is known to penetrate deeper in tissues when compared with blue light, can affect the sebum secretion of sebaceous glands and change keratinocyte behavior. Furthermore, red light might also exert its effects by modulating cytokines from macrophages and other cells, which in turn could reduce inflammation (Avci et al, 2013; Al-Salam et al, 2014).

2 CASE REPORTS

2.1 Patient 1

A 22-year-old man who has been suffering from acne vulgaris since he was fifteen. He complained from acneiform eruptions and scars, mainly affecting his forehead, cheeks, and chin. Patient had positive family history for acne vulgaris. Patient never treated his acne, but patient often squeezed his pimples. On dermatological examination found mainly papules, some pustules, nodules, and comedones (Figure 1). Based on acne grading evaluation by Lehmann in 2002, the lesions were counted (table 1) total 60 lesions and categorized as moderate acne vulgaris. Patient was treated with visible red light LLLT (655 nm, <5mW CW, 57 mrad) twice a week, interval 3 days, and 3 minutes

duration per treatment area. Follow up was taken for 4 weeks by lesions count and photographs.

2.2 Patient 2

A 28-year-old woman who has been suffering from acne vulgaris since one year ago. She complained from acneiform eruptions, mainly affecting her forehead, cheeks, and chin. Patient had negative family history for acne vulgaris. Patient had treated her acne with several topical treatment from online store, but no significant effect. On dermatological examination found mainly papules, some pustules, and comedones (Figure 2). Based on acne grading evaluation by Lehmann in 2002, the lesions were counted (table 1) total 46 lesions and categorized as moderate acne vulgaris. Patient was treated with visible red light LLLT (655 nm, <5mW CW, 57 mrad) twice a week, interval 3 days, and 3 minutes duration per treatment area. Follow up was taken for 4 weeks by lesions count and photographs.

At follow up, both patients got significant lesions reduction, with final total reduction after 8 sessions in 4 weeks for both patients were 63,3% and 74%, respectively. Final reduction of papules were 40% (patient 1) and 64,3% (patient 2). Final reduction of pustules were 93% (patient 1) and 86,7% (patient 2). Final reduction of nodules were 100% (patient 1). Final reductions of inflammatory lesions after 8 sessions in 4 weeks in both patients were 69,7% and 75,9%, respectively. And final reduction of non-inflammatory lesions (comedones) in both patients were 56% and 70,6%, respectively. Both patients showed satisfactory results in acnes' reductions (table 1 and 2).

Table 1. Acne lesions count in patient 1.

Lesions	Patient 1								
	Day 0	Day 7	Reduction (%)	Day 14	Reduction (%)	Day 21	Reduction (%)	Day 28	Reduction (%)
Papules	15	19	+26	13	13	10	33	9	40
Pustules	14	7	50	5	64	4	71	1	93
Nodules	4	2	50	1	75	-	100	-	100
Comedones	27	23	15	17	37	15	44	12	56
Total	60	51	15	32	47	29	52	22	63,3

Table 2. Acne lesions count in patient 2.

Lesions	Patient 2								
	Day 0	Day 7	Reduction (%)	Day 14	Reduction (%)	Day 21	Reduction (%)	Day 28	Reduction (%)
Papules	14	18	+29	10	29	8	43	5	64,3
Pustules	15	11	27	8	47	3	80	2	86,7
Nodules	-	-	-	-	-	-	-	-	-
Comedones	17	13	33	10	41	5	71	5	70,6
Total	46	42	9	28	39	16	65	12	74



Figure 1. A 22-yo male with moderate acne vulgaris; (A), (B), (C) before treatment ; and (D), (E), (F) after 8 sessions of red light LLLT treatments.



Figure 2. A 28-yo female with moderate acne vulgaris; (A), (B), (C) before treatment ; and (D), (E), (F) after 8 sessions of red light LLLT treatments.

2 DISCUSSION

The pathogenesis of acne is not completely understood, but the current hypothesis in the pathogenesis of acne including four major events: follicular hyperkeratinization, microbial colonization of *P. acnes*, increase sebum production, and complex inflammatory mechanisms. (Zaenglein et al, 2012). Usually the treatments of acne work by counteracting microcomedones formation, sebum production, *P. acnes*, and inflammation. Nowadays, it has been proposed that low level laser therapy could treat acne vulgaris with less side effects compared to other treatment options. (Avci et al, 2013)

LLLT knows as biostimulation or photobiomodulation laser. Biomodulations defined as changing the natural biochemical response of cells or tissue within the normal range of its function. (Avci et al, 2013) it appears that LLLT has a wide range of effects at the molecular, cellular, and tissue levels. The basic biological mechanism behind the effects of LLLT is thought to be through absorption of red and (nearly infrared) NIR light by mitochondrial chromophores, in particular cytochrome-c-oxidase (CCO), which is contained in the respiratory chain located within the mitochondria, (Avci et al, 2013;Karu et al,2005) and perhaps also by photoacceptors in the plasma membrane of cells. Consequently, a cascade of events occur in the mitochondria, leading to biostimulation of various processes. (Avci et al, 2013) Absorption spectra obtained for CCO in different oxidation states were recorded and found to be very similar to the action spectra for biological responses to the light. (Avci et al, 2013;Karu et al,2005) It is hypothesized that this absorption of light energy may cause photo dissociation of inhibitory nitric oxide from CCO, leading to enhancement of enzyme activity, electron transport, mitochondrial respiration, and adenosine triphosphate production. (Papageorgiou et al,2000) In turn, LLLT alters the cellular redox state, which induces the activation of numerous intracellular signaling pathways, and alters the affinity of transcription factors concerned with cell proliferation, survival, tissue repair, and regeneration. (Avci et al, 2013;Karu et al,2005)

The mechanism of actions of red light LLLT in the pathogenesis of acne are through its effects in interfere sebum secretion of sebaceous gland and change keratinocytes behaviors. Furthermore, red light might also exert its effects by modulating cytokines from macrophages and other cells, which

in turn could reduce inflammation. Also, the absorption of light by porphyrins that have been produced by *P. acnes* as a part of its normal metabolism, and that act as endogenous photosensitizers. This process causes a photochemical reaction and forms reactive free radicals and singlet oxygen species which in turn lead to bacterial destruction (Avci et al, 2013;Al-Salam et al,2014) From this mechanisms, it revealed that LLLT plays role in reducing follicular hyperkeratinization, suppressing microbial colonization of *P. acnes*, decreasing sebum production, and reducing inflammations in the pathogenesis of acne.

In our case series, we modified the use of red light LLLT tool which is usually used for alopecia or hair loss, by treating acnes per area for 3 minutes. Both patients got significant lesions reduction, with final total reductions after 8 sessions in 4 weeks for both patients were 63,3% and 74%, respectively. Final reduction of non-inflammatory lesions (comedones) for both patients were 56% and 70,6%, respectively. And final reduction of inflammatory lesions for both patients were 69,7% and 75,9%, respectively. Several studies had reported the usage of LLLT in acne vulgaris, but most of them using combination of blue and red light LLLT. Papageorgiou et al. reported the mean improvement of 76% in inflammatory lesions and 57% in comedones. (Papageorgiou et al,2000) Goldberg et al. reported mean lesion count reduction 46% after 4 weeks, after 12 weeks 81%, where the severe acne showed a marginally better response than mild acne, but comedones did not respond as well as inflammatory lesions.(Goldberg et al,2006) Lee et al. reported final mean improvements in non-inflammatory lesions (34,28%) and inflammatory lesions (77.93%), and also brightened skin tone and improved skin texture were spontaneously reported by 14 patients. (Lee et al,2007). Sadick reported final average reduction of acne was 69% at the 12th weeks assessment.(Sadick et al,2008) All the reports above were using the combination of blue and red light LLLT in their treatment of acne. Aziz-Jalali et al. compared the usage of red light (630 nm) and Infrared LLLT (890 nm) with results after 10 weeks treatment, acne lesions were significantly decreased in the side treated by 630 nm (27.7±12.7 to 6.3±1.9), but not significant in the site treated by 890 nm (26.9±12.4 to 22.2±8.5).(Aziz-Jalali et al,2012)

Our treatment method for acne, alternating red light LLLT, was easy to deliver, well-tolerated, pain- and side-effect free, and gave a satisfyingly

high clearance rate in patients with non-inflammatory and inflammatory acne. Unfortunately, there was a limitation in this case series because of relatively short follow-up period to its long term efficacy and side effects. However, the high percentage of clearance in the non-inflammatory and inflammatory acne after 4 weeks treatment assessment, and the concordance of this result with other studies, mean that further investigation to determine the efficacy and to optimize the treatment parameters for red light LLLT.

3 CONCLUSION

Red light LLLT was effective as an alternative modality in reducing both non-inflammatory and inflammatory type lesions in acne vulgaris. The mechanism of actions of red light LLLT as the treatment of acne vulgaris are through its roles in the pathogenesis of acne by reducing follicular hyperkeratinization, suppressing microbial colonization of *P. acnes*, decreasing sebum production, and reducing inflammations.

REFERENCES

- Al-Salam FA, Afify W. 2014. *Low Level Laser Therapy in Dermatology*. The Gulf Journal of Dermatology and Venereology 21(2):1-14.
- Aydemir, E.H. 2014. *Acne vulgaris*. Türk Ped Arş. 49:13-6. DOI:10.5152/tpa.2014.1943
- Avcı P, Gupta A, Sadasivam M, et al. 2013. *Low-level laser (light) therapy (LLL) in skin: stimulating, healing, restoring*. Semin Cutan Med Surg 32(1): 41–52.
- Aziz-Jalali MH, Tabaie SM, Djavid GE. 2012. *Comparison of Red and Infrared Low-level Laser Therapy in the Treatment of Acne Vulgaris*. Indian J Dermatol. Mar 2012; 57(2):128–130.
- Goldberg DJ, Russell BA. 2006. *Combination blue (415 nm) and red (633 nm) LED phototherapy in the treatment of mild to severe acne vulgaris*. J Cosmet Laser Ther. 8(2):71–75.
- Lee SY, You CE, Park MY. 2007. *Blue and red light combination LED phototherapy for acne vulgaris in patients with skin phototype IV*. Lasers Surg Med. 39(2):180–188.
- Karu TI, Kolyakov SF. 2005. *Exact action spectra for cellular responses relevant to phototherapy*. Photomed Laser Surg. 23(4):355–361. [PubMed: 16144476]
- Papageorgiou P, Katsambas A, Chu A. 2000. *Phototherapy with blue (415 nm) and red (660 nm) light in the treatment of acne vulgaris*. Br J Dermatol. 142(5):973–978.
- Sadick NS. 2008. *Handheld LED array device in the treatment of acne vulgaris*. J Drugs Dermatol. 7(4):347–350.
- Suva MA, Patel AM, Sharma N, et al. 2014. *A Brief Review on Acne Vulgaris: Pathogenesis, Diagnosis and Treatment*. RRJoP. 4(3):1-12.
- Zaenglein AL, Pathy AL, Schlosser BJ, et al. 2016. *Guidelines of care for the management of acne vulgaris*. J Am Acad Dermatol. J Am Acad Dermatol.
- Zaenglein AL, Graber EM, and Thiboutot DM. 2012. *Acne Vulgaris and Acneiform Eruptions*. In : Goldsmith L.A., Katz S.I., Gilchrist B.A., Paller A.S., Leffell D.J., Wolff K. (Eds.) : *Fitzpatrick's Dermatology In General Medicine*. 8th edition. New York : McGraw-Hill Companies. p.897-917.