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RESEARCH ARTICLES

Comparison of the Effectiveness of Blue Light Therapy as an Adjuvant Therapy with Topical Antibiotics in Acne Vulgaris Patients

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Abstract: Acne vulgaris, commonly known as acne, is one of the most common disorders of the skin due to disorders in the sebaceous glands or oil glands that are found on the skin. Management of *acne vulgaris* can be given in the form of antibiotics, accompanied by additional therapy to somewhat increase the effectiveness of healing. One of the additional therapies provided is *Photodynamic Therapy* (PDT). This study aims to compare the level of effectiveness of blue *light therapy* as *an adjuvant* therapy with topical antibiotics in *acne vulgaris patients* at the Faculty of Medicine, University of Muhammadiyah North Sumatra, Batch 2020, 2021, 2022 and 2023. This study involved 32 student subjects who had *acne vulgaris. This study* is an observational study with *the prospective cohort method.* Students who are indicated to have a severity level of 2 based on the *Global Acne Grading System* are given therapy. The collected data were processed with the Wilcoxon Test. The results showed a decrease in severity with topical antibiotics in as many as 7 people (20%) and topical antibiotics with photodynamic therapy in as many as 12 people (80%), with the highest gender distribution in women (72%). The results of the data test showed no significant relationship or difference between the two treatment groups. The conclusion of this study did not find a significant difference between the two treatment groups, but the number of samples that recovered in the group of topical antibiotics with additional therapy was much higher.

Keywords: Acne vulgaris*, blue light therapy,* severity.

INTRODUCTION

Acne vulgaris or commonly known as acne, is one of the most common disorders of the skin due to disorders of the sebaceous glands or oil glands found on the skin.[1] The sebaceous glands, or commonly called oil glands, are found all over the body except for the surface of the palms and the surfaces of the soles of the feet. These glands produce an oily substance called sebum, which consists of a mixture of fats, dead skin cells and other materials that help maintain skin moisture and maintain its elasticity. Disorders of the sebaceous glands can create follicle keratinisation disorders where there is an increase in the

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production of dead skin cells, which increases the production of sebum, which then clogs the pores, so that it becomes an ideal condition for acne-causing bacteria to multiply, so to inflammation and the formation of acne or acne vulgaris.[2]

The Global Burden of Disease in 2019 stated that acne vulgaris accounted for 4-96 million (95%) of the occurrences in 2019, with 3-52 million occurring at the age of 15-49 years. Meanwhile, the prevalence of acne in Indonesia ranges from 80-85% of people with an age range from teenagers to young adults.[1] Acne is considered the most common skin disorder after dermatitis. Acne disorders affect many things, including reduced self-confidence due to scars, post-inflammatory hyperpigmentation. The condition of acne vulgaris has a clinical picture in the form of blackheads (open or closed, as well as black and white), papules, pustules, nodules to cysts and scar tissue.[3]

In today's era, there are many developments in the field of technology; therefore, various ways have been found to treat acne vulgaris and its scars. Acne management is classified as topical and systemic treatment.[4] The administration of the type of drug is determined by the severity of the acne. Topical management has a mechanism that kills acne vulgaris bacteria located around acne lesions.[5] Antibiotics are considered to be able to kill bacteria through the pores of the skin because they have direct anti-inflammatory properties that can reduce periorbital lymphocytic infiltration. The length of time acne heals with antibiotics can be shortened by including additional therapy or *adjuvant therapy*. One of the additional therapies given is *Photodynamic Therapy* (PDT), or photodynamic therapy. *Photodynamic therapy* (PDT) is a therapy that combines light energy with a drug (*photosensitizer*) that is activated by a specific wavelength of light energy. Several studies related to the use of photodynamic therapy state that this therapy is good for the treatment of skin conditions such as acne vulgaris.[6] Therapy using blue light is an adjuvant therapy that can be done because the bacterium *Cutiibacterium acnes* (c. acnes) produces porphyrins that can absorb light in the ultraviolet spectrum and blue light that can destroy bacteria, so that it can reduce the inflammatory effects caused by bacteria on lesions. The effects depend on the wavelength, frequency, and mechanism of action of the light, but some also depend on the time of illumination and the dose. Chromophores are molecules that can absorb light, so the effect of the rays used depends on different chromophores (photoacceptors). The main photoacceptors consist of opsin, flavin, porphyrin, and nitrosated proteins.[7]

In this study, the researcher will provide antibiotic therapy with photodynamic therapy using blue light as an additional therapy.[9] The use of topical antibiotics chosen is clindamycin gel 1% which is used 2 times, namely morning and evening, every day in patients with the severity of acne at level 4. After that, additional therapy in the form of blue light photodynamic therapy will be given 2 times a month.[10,11,12]

Photodynamic therapy is classified as a therapy with a high success rate in various fields.[8,13] However, in the treatment of acne vulgaris, this therapy is less highlighted as

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an adjunct therapy.[14] Many people do not know photodynamic therapy as an additional therapy that can speed up the healing process in acne vulgaris.[15] This therapy also has minimal side effects and is considered safe to do as an adjunct therapy for acne vulgaris in the clinic.[16] Therefore, researchers are interested in conducting a study to compare the level of effectiveness between *blue light therapy* as an adjuvant therapy and topical antibiotics in acne vulgaris.

METHODS

This study is in the form of an observational method with *the cohort prospective study* method to assess the level of effectiveness of blue light therapy as an adjuvant therapy with topical antibiotics to acne vulgaris patients where the study will be conducted for 4 weeks by assessing the condition of acne vulgaris in the research sample before and after receiving therapy that will be given by a dermatologist. The severity chosen in this study is a moderate degree or degree 2, where the therapy will be given in the form of topical antibiotics, namely clindamycin gel 1% which is used every 2 times a day, with additional therapy in the form of *blue light therapy* every two weeks. In this study, moderate acne was chosen, accompanied by topical antibiotic administration, because the administration of therapy for acne was given according to the degree of severity, where in severe degrees oral antibiotics can be used and in moderate degrees by using topical antibiotics.

RESULTS

The results of the research data are in the form of primary data obtained directly by the researcher when conducting research in the practice of dermatologists and veneers.

Table 1. Distribution of subject frequencies by gender

Gender	Frequency (n)	Percentage (%)
Male	7	28
Women	23	72
Total	**30**	**100**

Based on Table 1 above, it appears that in this study, there are more female research subjects compared to men, namely, women as many as 23 (72%) people and men as many as 7 (28%) people.

Table 2. Distribution of Total Severity Before and After Topical Antibiotic Therapy and Topical Antibiotics with *Blue Light Therapy*

	Degree of Severity					
	Before Therapy (Degrees)		After Therapy (Degrees)			
			Degree 1		Derajat 2	
Treatment Groups	n	%	n	%	n	%
Topical Antibiotics	15	100	7	43.8	8	56.3
Antibiotik Topikal dengan *Blue Light Therapy*	15	100	12	80.0	3	20.0

Based on Table 2 above, it was found that the most significant decrease occurred in the group with topical antibiotic treatment accompanied by blue light therapy, namely 12 people (80%), while in the group with topical antibiotic administration, there were only 7 people

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(44%) who experienced a decrease in severity after one month of therapy.

Table 3. Comparison of Effectiveness Levels *of Blue Light Therapy* with Topical Antibiotics as a Treatment for Acne Vulgaris

Variabel	Results		
	n	Mean	*p*
Topical Antibiotic Postestest	7	4.00	0.008
Postest Antibiotik Topikal & *Blue Light Therapy*	12	7.00	0.000

After being analysed using the Wilcoxon test, a *value of sSig (2-tailed)* or *p* of 0.008 in the group of topical antibiotics only and 0.000 in the group of topical antibiotics with *blue light therapy,* where the amount is less than 0.05, it is concluded from both treatments that they are equally effective in the treatment of acne vulgaris. However, the results of this data test also prove that there is a difference in the number of samples that experienced a greater decrease in severity in the group with topical antibiotics accompanied by additional therapy.

DISCUSSION

Based on the results of the research that has been presented, overall, the sample that participated at the beginning had a variety of acne severity, but because in this study moderate acne was needed, after a dermatological examination and anamnesis, 30 students with moderate acne were selected.

Based on the data displayed earlier, it was found that there were more female students than male students. This statement is also supported by Amita's research, where acne is more common in women. According to *the Global Burden of Disease* from acne incidence worldwide, the majority of acne vulgaris sufferers are women.[1,18] However, this certainly states that men can also experience acne vulgaris. This is caused by the cause of acne vulgaris is clogging of pores due to sebum and resulting in infection of *cutiibacterium acnes* bacteria, so that acne lesions appear in the form of papules, pustules and nodules. In addition to gender, race also affects the occurrence of acne vulgaris. Asian races are among the races that most often suffer from acne, followed by white skin colour. Other factors support the occurrence of acne, such as stress levels, dietary habits, cosmetic and genetic factors [9 10]

Bacteria are the most dominant skin microbiome, with more than 40 genera of bacteria having been successfully identified on the skin, including *Cutibacterium acnes.* The scalp and facial skin have the highest risk of infection with this bacterium.[2] This condition is in accordance with the dominant location of acne in this study sample, where most of the samples experience acne infection on the skin of the face and then followed by acne on the back. The results of the study that have been carried out show that there is no difference in the results of acne vulgaris therapy between the two research groups. This is evidenced by the data test using Wilcoxon with a significance value (*p-value)* of 0.000 (*p<0.05) for the topical antibiotic group accompanied by blue light therapy* and 0.008 (*p<0.05) for the topical antibiotic group only.* However, what can be highlighted from the results of this study is that there was a significant decrease in severity in the group of topical antibiotics

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with *blue light therapy* as many as 12 people (80%) out of 15 study samples in the group. Meanwhile, in the group that used topical antibiotics alone, there was only a decrease of 7 people (20%) from the 15 samples in the group. The results of this study concluded that the administration of topical antibiotics accompanied by blue light therapy has a higher level of effectiveness than therapy with topical antibiotics alone.

In Anna's study of blue light therapy, it was found that the state of the sample that experienced a decrease in severity was much higher than other samples that did not receive blue light therapy.[22] This is in line with the results of my study, where the reduction in severity occurred more in the sample using topical antibiotics accompanied by the administration of blue light therapy once every two weeks for one month.

Antibiotics in the treatment of acne vulgaris are given according to the degree of severity experienced, in this study, we used clindamycin gel 1% which was chosen as the most widely used type of drug because it has a high success rate[25], This is also followed by the results of research from Seila, where clindamycin gel 1% has good thermal content so that the melting of the drug and the reaction to the bacterial unit (in this case the cause of acne) becomes very good.[5] Based on Linda and her friends' research, antibiotics themselves have anti-inflammatory abilities and, depending on the formulation, also have bacteriostatic or bactericidal properties or the ability of substances or agents to inhibit bacterial growth and reproduction. [26]

Clindamycin is an antibiotic of the lincosamide group, which is a derivative of the *actinomycete Streptomyces lincolnensis,* invented in 1952 and widely used in various types of bacterial infection treatment. Clindamycin works on bacteria by blocking protein synthesis involving central inhibition of peptidyl transferase, so that clindamycin can inhibit bacterial growth and prevent its proliferation. The action of clindamycin depends on the dose given; there are times when the dose of clindamycin shows bacteriostatic properties. There is an inhibition of bacterial growth that does not cause the death of the bacteria directly. At high doses, clindamycin has bactericidal properties that can kill bacteria directly. In *Cutibacterium acnes,* there is the production of lipase protein, which breaks down triglycerides into free fatty acids, which further results in irritation and pro-inflammatory effects and increases perifollicular. Clindamycin can reduce the amount of *Cutibacterium acnes,* resulting in a reduction in free fatty acids, which further reduces inflammation and the risk of blackheads.[27]

In addition to clindamycin, another type of antibiotic that is widely used is erythromycin. In general, the mechanism of action of erythromycin is not much different from clindamycin in general. The salient difference between these two types of antibiotics is that erythromycin is more successful only in gram-positive bacteria, while clindamycin has a fairly broad spectrum, not only in gram-positive bacteria but also in gram-negative bacteria. The use of erythromycin antibiotics was also considered to have a fairly high level of resistance; the UK and India (94.4% and

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98% respectively) had a fairly high level of bacterial resistance to erythromycin [28]

Tetracycline is one of the antibiotics used in the treatment of severe acne vulgaris. In this condition, the use of antibiotics is given orally. Tetracycline is effective in the treatment of acne vulgaris, but this is also followed by an increasing incidence of resistance. Resistance to tetracycline varies from 2% to 30%. The antibiotic doxycycline, which is a type of tetracycline, also has a high level of resistance, ranging from 2% to 44.2% with different effects depending on the group of patients receiving it. The type of tetracycline that has a low level of resistance is minocycline, ranging from less than 2% of this agent to be the most effective antibiotic for acne vulgaris in some regions such as Europe, Latin America, North America and parts of Asia. The mechanism of tetracycline involves mutation in the 16S rRNA gene and amino acid substitution in ribosomal protein S10 from *the bacterium Cutibacterium acnes.*[2]

There are many types of antibiotics, both topical and oral, that can be used in acne vulgaris therapy. The use of antibiotics is expected to kill bacteria that develop on lesions and pores. The management of antibiotic use itself is given based on the severity of each individual. Mild degrees generally use topical antibiotics, and severe degrees use oral antibiotics.[29] In this study, the severity studied was moderate, so topical antibiotics were used. The topical antibiotic used is clindamycin gel 1%. The use of clindamycin is not recommended as monotherapy, so it is recommended to get additional or accompanying therapies that help the process or mechanism of the topical agent. This is in accordance with Xiaoqiong's research, where *adjuvant* therapy or adjunct therapy has the goal of increasing the clinical efficacy of the given treatment.[17] One example of additional therapy that can be used as a treatment in the clinic is *photodynamic therapy* or photodynamic therapy. This therapy uses light and photosensitive substances to give rise to *reactive oxygen species* (ROS).[19] These molecules contain hydroxyl radicals, superoxide and hydrogen peroxide, which can have antibacterial effects. ROS can damage the cell membrane of bacteria with cellular components.[20,21] The use of ROS must be carried out in a measured manner to produce an anti-inflammatory effect, as excessive use of ROS can cause the inflammatory reaction itself and result in uncontrolled cell growth.[22,23]

Acne vulgaris therapy using antibiotics is also affected by the user's level of compliance. The compliance in question in this case can be in the form of a schedule of use.[24,25] In the study conducted by Sevimli, some samples came out in the middle of the study due to forgetfulness in using antibiotics or due to side effects.[29] In samples with the use of combined management, the incidence of side effects tended to be lower. In my study, the use of topical antibiotics was given for 4 weeks, and should be used every morning and night. Regular use of antibiotics is also a major factor in the decrease in severity, so samples regularly submit evidence of topical antibiotic use. [23]

Therapy was carried out for 4 weeks, with blue light administration done every two weeks, with a duration of administration of 20 minutes. According to

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Mara's research, giving blue light twice every few weeks can reduce the level of inflammation by 40%.[22] This is clearly in accordance with the results of the research, where there was a significant difference in the amount of severity reduction in severity for the blue light group of topical antibiotics and the group of topical antibiotics only.

The determination of the degree of decrease is carried out through a dermatological examination by a venereal dermatologist, with an assessment of the inflammatory area in the patient.[25] The inflammatory region initially decreases during the first week of topical antibiotic use, but in some samples without blue light therapy, followed by an unresponsive nature factor, the inflammatory region usually increases again.[27] In samples with good adherence, the use of topical antibiotics alone was sufficient to reduce the severity of acne. In samples with topical antibiotics, accompanied by blue light therapy, in 4 weeks, the inflammatory region was well reduced, and there were no reports of an increase in severity again.[29]

CONCLUSION

The distribution of acne vulgaris patients by severity is at moderate or level 2, with a more even sex distribution in females than males. There was no significant difference between the two groups, but it was found that the number of recovered patients was higher in the group of topical antibiotic treatment with additional Blue *Light Therapy* as many as 12 people out of 15 samples, with a total of 30 students of the Faculty of Medicine, University of Muhammadiyah North Sumatra.

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