A Study of Biochemical Markers of Oxidative Stress in Acne Vulgaris Patients

Dr Anubhav Gosai[1], Dr Rupendra Sao[2], Dr Bijay Kumar Mahaseth [3]

1. Dr Anubhav Gosai, Associate Professor, Department of Dermatology, SBIMS, Raipur,C.G., anubhavgosai@gmail.com
2. Dr Rupendra Kumar Sao, Assistant Professor, Department of Biochemistry, SSIMS, Bhilai, C.G., rupendrakumarsao@gmail.com
3. Dr Bijay Kumar Mahaseth, Associate Professor, Department of Biochemistry, SSIMS, Bhilai, C.G., bijaymahaseth@gmail.com

Corresponding Author:

Dr Bijay Kumar Mahaseth, Associate Professor, Department of Biochemistry, SSIMS, Bhilai, C.G., bijaymahaseth@gmail.com

Abstract

Background: Acne vulgaris is a chronic inflammatory skin disease of the pilosebaceous unit. **Aim and Objective:** To study of biochemical marker of oxidative stress in Acne vulgaris patients. **Method:** 25 acne patients and 25 healthy people were selected and their serum levels of superoxide dismutase SOD and Malondialdehyde MDA were estimated and the results are compared with the control group. Also, the relationship between the duration and severity of acne with the parameters is assessed. **Result:** The activity of SOD is found to be decreased and the level of MDA is found to be increased in acne patients compared to healthy people, suggesting increased oxidative stress in Acne vulgaris patients. **Conclusion:** The stronger response observed in serum samples from patients with higher GAGS scores suggests that markers of oxidative stress may be useful in evaluating the progression of acne and in elucidating the mechanisms of disease pathogenesis.

Keywords: Acne vulgaris, SOD, MDA

Introduction

Acne vulgaris represents one of the most prevalent skin disorders in late childhood and teenage years [1]. Acne, a condition with a complex pathophysiology, may be caused by immunological and inflammatory processes, sebaceous hyperplasia, microorganism hypercolonization, and follicular hyperkeratinization [2]. Cutibacterium acnes, formerly identified as Propionibacterium acnes, generates lipases and proteolytic enzymes, which may have an essential function in the inflammatory phase [3]. Furthermore, acne vulgaris is characterized by comedones, inflammatory spots, and subsequent dyspigmentation [4]. In addition, several hypotheses have been developed, but no hypothesis fully explains the pathophysiological mechanisms and the entire involvement of etiological factors.

It is exclusively a human disease most commonly affecting sebaceous follicles of the face, chest, and back. It affects about 85% of adolescents and begins in the prepubertal period. It usually regresses spontaneously, but in about 5% of cases, acne

will persist beyond the age of 24 and may extend up to the fourth and fifth decades of life [5]. The pathogenesis of Acne is multifactorial. It mainly involves excess sebum production, abnormal keratinization of follicles, Propionibacterium acnes colonization, and inflammation of the follicle and surrounding dermis [6]. The experience of acne may not be life-threatening per se, but it does carry significant psychological disability with it. Higher levels of depression, anxiety, anger, and suicidal thoughts are noted in acne patients [7]. Studies have shown that patients with acne have a more significant impairment of mental health compared to many other chronic conditions like epilepsy, diabetes, etc [8, 9]. The gravity of the involvement of oxidative stress in the pathophysiology of acne had been a matter of question over the past few years. Various studies have shown that patients with acne are under increased oxidative stress, both systemic and cutaneous [10]. Reactive oxygen species production by neutrophils was cause irritation and destruction of the follicular wall and are thought to be responsible for inflammatory progression. Inadequate antioxidant production and/or excess reactive oxygen species production leads to oxidative stress. Oxidative stress contributes to the development of Acne [10-12]. Although Acne vulgaris is a common skin disease affecting both sexes of the second decade, only a few studies are done to assess the antioxidant status of acne. The present study aims to determine the role of oxidative stress in *Acne vulgaris patients.*

Materials and Methods

Hospital-based study done at the Department of Dermatology and Biochemistry, SBIMS, Raipur. The study was carried after the approval of Institutional Ethics Committee and the informed consent was taken from the parents of the infant subjects. Sample size: The current study included 25 acne vulgaris patients diagnosed by a dermatologist serve as cases and 25 healthy volunteers served as controls aged between 20-40 y included in the study

Inclusion criteria

Acne patients, clinically diagnosed, both male and female, between 20-40yrs of age. Graded using "The Global Acne Grading System" (GAGS)-is a quantitative scoring system in which the total severity score is derived from the summation of six regional subscores. Each is derived by multiplying the factor for each region by the most heavily weighted lesion within each region (factor for forehead and each cheek is 2, chin and nose is 1, and chest and upper back is 3) (1 for ≥ one comedone, 2 for ≥ one papule, 3 for ≥ one pustule and 4 for ≥ one nodule). The regional factors were derived from consideration of surface area, distribution, and density of pilosebaceous units.

Exclusion criteria

Patients with systemic illness, with the habit of smoking or alcohol abuse, those who are on treatment (systemic or topical) for the prior three months, and those who are not willing to participate in this study are excluded. The comparative group is taken from the preventive clinic. (otherwise, healthy people come for routine vaccination).

Collection of samples

About 5 ml of fasting blood sample was drawn under strict aseptic precautions and centrifuged serum sample was stored at-200C. SOD and Malondialdehydeactivity was measured by using the kit by Erba fully Autoanalyzer was measured.

Statistical Analysis

The Data analysis was performed in Microsoft Office Excel 2010 and Statistical Package for the Social Sciences, version 24.0 (SPSS software). Pvalues considered significant were as follows: P-value <0.05– As significant and P-value <0.001 – As highly significant.

Socio-demographic parameters

Age distribution among patients and healthy volunteers

In the present study, the highest prevalence of acne was found to be in the age group less than 30 y followed by 25-30 and 30-35 y; the last two groups shared an equal prevalence .

Gender distribution among patients and healthy volunteers

In the present study, 60% of cases were females and the rest 40 were males. In controls, 52% were females, and rest 48% were males.

Severity among cases

The cases were graded according to the global acne grading system and in the present study, 40% of cases were having mild acne, another 35% were having moderate acne and the rest 25.% of cases were having severe acne vulgaris.

Duration among cases

In this study, 30% of cases had the disease for more than 3 y, 15% had the disease for 2-3 y, and another 16% have the disease for 1-2 y. 39% of the cases had the disease for only one year.

Table 1: Depict the mean values of SOD and MDA in hypothyroidism patients compared with control

Parameters	Case (Mean ± SD)	Control (mean ± SD)	P-value
SOD(units/ml)	106.08±6.26	156.32±23.35	0.000
MDA	109.16±4.82	86.6±5.7	0.000

Table 1 and Figures 1 and 2 show the difference in the mean level of SOD (4.09 ± 0.94) in hypothyroidism and in controls of MDA (3.06 ± 0.55) found to be statistically significant.

significant.

Table 3: Serum SOD and MDA among different severities of acne patients

Severity	No.	SOD units/ml (mean ± SD)	MDA nmol/dl (mean ± SD)	P-value
Mild	11	99.18±4.16	105.36±2.5	0.0004
Moderate	9	95.11±3.95	112.44±8.26	0.0003
Severe	5	120.4±2.07	101±1.58	0.00057
Total	25	106.08±6.26	109.16±4.82	0.0000

Although serum SOD is found to be highest among the severe group of acne, it turned out not to be significant statistically, and there is also no statistically significant relation between MDA among different severity of acne.

Table 4: Serum SOD and MDA among different age groups of acne patients

Age group	No.	SOD units/ml (mean ± SD)	MDA (mean ± SD)	P-value
<25	22	136.27±9.01	94.68±15.99	1.76
25-30	18	129.4±8.62	97.6±22.66	0.0000
30-35	6	144.33±10.13	101.16±5.26	0.0000
>35	4	100±1.82	95.5±3.81	0.077
Total	50			

There is no statistically significant relationship between SOD and MDA among different age groups of acne, and there is also no statistically significant relationship between MDA and SOD and MDA among different age groups of acne, and there is also no statistically significant relationship between MDA and SOD among different age groups of acne.

Discussion

Acne vulgaris is one of the most common skin disorders affecting the pilosebaceous unit in the skin. It is characterized by seborrhea, comedones (blackhead and whitehead), papules, pustules, and sometimes scarring of the skin [13]. The role of oxidative stress (OS) has been intensively studied in inflammatory skin conditions such as psoriasis, vitiligo, or atopic dermatitis.It is common in adolescence and may proceed into adulthood, affecting roughly 33% of people aged between 15 and 44 years [14]. Despite the research, the etiology and pathogenesis of acne are not completely understood, and a single, primary cause has not been identified [15].

This hospital-based study was done to determine the extent of oxidative stress in acne vulgaris. In the present study, various biochemical parameters, like serum superoxide dismutase and malondialdehyde, were analyzed in this study, 25 acne vulgaris patients and 25 healthy volunteers in the age group of 20–40 years were selected.

In the present study, the highest prevalence of acne was found in the age group less than 25 years old, followed by 25–30 years old and 35–40 years old. The last two groups shared an equal prevalence of 40%. In this study, 60% of cases were female, and the rest were male. In controls, 52% were females, and the rest were males. The cases were graded according to the global acne grading system, and in the present study, 44% of cases had mild acne, another 36% had moderate acne, and the rest, 2519%, had severe acne vulgaris. In this study, 30% of cases had the disease for more than 3 years, 15% had the disease for 2-3 years, and another 16% had the disease for 1-2 years. 39% of the cases had the disease for only one year. The mean SOD value among acne patients is 106.08 units/ml, and that among healthy controls is 156.32 u/ml. The difference was found to be statistically significant (*p-value*<0.001). The mean MDA value among acne patients is 109.14 ng/dl, and that of healthy controls is 86.6 ng/dl. The difference was found to be statistically significant (p-value<0.001).

This result is similar to many studies. In a study conducted by Al-Shobaili *et al.*, 50 acne vulgaris patients with varying levels of severity according to the global acne grading system and 40 age- and sex-matched controls were evaluated. In their study, they found out that SOD levels were low and MDA levels were high in acne patients compared to healthy volunteers. The difference was also statistically significant (p<0.001) [16]. In another study conducted by M. A. Ibrahim *et al.*, 40 acne vulgaris patients and 36 age- and sex-matched controls were evaluated for oxidant-antioxidant status. A highly significant decrease in SOD and other antioxidant enzyme activity (*p-value*<0.001) and a highly significant increase in serum MDA (*p-value*<0.001) were detected in patients compared to healthy controls [17]. Similar results were obtained in a study conducted by G. Sarici *et al.* [7].

Another study done by Al-Shobaili *et al.* found that plasma levels of SOD and catalase were lower and MDA was higher in patients compared to healthy people [15]. Similar results were obtained in a study done by AhemmadSali Sahib *et al.*, where serum MDA was significantly elevated in acne patients compared to control (*p value<0.001*) [16]. Lower levels of SOD in acne patients compared to controls were obtained in a study conducted by Pinar Y *et al.* [18]. There is no significant association between any of the parameters and age group, disease severity, or disease duration among acne patients. This also agrees with the study of Ibrahim *et al.* [19].

Also, there are a few studies that disagree with the result of the present study. A study conducted by Gaber, M. A., *et al.* on 27 acne patients and 10 controls showed a significantly higher level of SOD and MDA in acne patients compared to controls (*p-value*<0.001) [20].

In another study done by El Garemetal, 50 acne patients were compared with 20 healthy controls. Although the result showed a higher SOD in acne patients compared to controls, that was found not to be statistically significant [21]. Another study done by Arican, Ozer, *et al.* came up with the result of elevated SOD and MDA in patients compared to the control (*p-value*<0.001) [22]. In a study done by Fattahe et *al.*, 23 acne patients were compared with 23 age- and sex-matched controls. There was no significant difference in SOD and MDA levels between cases and controls [23]. In a recent study by Awad *et al.* in 60 patients, 40 control subjects found significantly higher serum MDA in acne patients compared with control subjects with lower total antioxidant activity (TAC) [24], and another study by Moazen M *et al.* also shows higher serum MDA in acne patients compared with controls [25].

In a similar study done by J. **R.** *et al.,* the highest prevalence of acne was found to be in the age group less than 20 years, followed by 20–24 years, and 25–29 years. The last two groups shared an equal prevalence of 28.6%. In this study, 65.7% of cases were female, and the rest were male. In controls, 54.3% were females, and the rest were males. The cases were graded according to the global acne grading system, and in the present study, 37.1% of cases had mild acne, another 37.1% had moderate acne, and the rest, 25.7%, had severe acne vulgaris. In this study, 31.4% of cases had the disease for more than 3 years, 14.3% had the disease for 2-3 years, and another 14.3% had the disease for 1-2 years. 40% of the cases had the disease for only one year. [26] A recent study shows that oxidative stress plays a major role in the pathophysiology of acne through several other pathways, such as PPARs, mTOR, and TLRs [27]. Another study states that, due to their anti-oxidative properties, vitamin A derivatives can be used for the treatment of acne vulgaris [28].

Strengths and Limitations of the Present Study

There are a few limitations to the study. In the present study, only 20–40-year-old subjects participated in the research. Hence, in the feature, we would like to include an increase in the number of participants to reach a concrete conclusion. The present study was given an impact to understand how the concentration of SOD and MDA is involved in the acne vulgaris patients.

Conclusion

The present study shows that oxidative stress plays a key role in the pathogenesis and progression of acne vulgaris. Biomarkers of oxidative stress are elevated in acne vulgaris patients, irrespective of the degree of severity. Antioxidants can be used as an effective method of treatment in acne vulgaris patients.

References

1. F. Bergfeld, The pathophysiology of acne vulgaris in children and adolescents, part 2: Tailoring treatment, Cutis, 7 4 (3) (2 0 0 4), pp. 1 8 9 -1 9 2

2. Gollnick et al., Current Concepts of the Pathogenesis of Acne: Implications for Drug Treatment, 6 3 (1 5) (2 0 0 3), pp. 1 5 7 9 -1 5 9 6.

3. Burkhart et al., Clinical assessment of acne pathogenesis with treatment implications, Int. Pediatr., 1 8 (1) (2 0 0 3), pp. 1 4 -1 9.

4. Endres, D.M. Tit, S. Bungau, et al., Incidence and clinical implications of autoimmune thyroiditis in the development of acne in young patients, Diagnostics, 1 1 (5) (2 0 2 1), p. 7.

5. Dikshit A., Qidwai A., Pandey M., et al. Risk factor assessment for acne vulgaris in humans and implications for public health interventions in north-central India: A survey-based study. Asian J Pharm Clin Res. 2017;10(5).

6. Prasad SB. Acne vulgaris: a review on pathophysiology and treatment. Asian J Pharm Clin Res. 2016;9(4, Jul):54–9.

7. Sarici G, Cinar S, Armutcu F, Altinyazar C, Koca R, and Tekin NS. Oxidative stress in acne vulgaris. J Eur Acad Dermatol Venereol. 2010 Jul;24(7):763-7.

8. Loney T., Standage M., and Lewis S., Not just'skin deep': psychosocial effects of dermatological-related social anxiety in a sample of acne patients. J Health Psychol. 2008 Jan;13(1):47–54.

9. Mallon E, Newton JN, Klassen A, Stewart Brown SL, Ryan TJ, and Finlay AY. The quality of life in acne: a comparison with general medical conditions using generic questionnaires. Br J Dermatol. 1999 Apr;140(4):672-6.

10. Briganti S., Picardo M. Antioxidant activity, lipid peroxidation, and skin diseases. What's New? Eur Acad Dermatol Venereol. 2003 Nov;17(6):663-9.

11. Oztas MO, Balk M, Ogus E, Bozkurt M, Ogus IH, and Ozer N. The role of free oxygen radicals in the aetiopathogenesis of rosacea. Clin Exp Dermatol. 2003 Mar;28(2):188-92.

12. Dalle Carbonare M., Pathak MA. Skin photosensitizing agents and the role of reactive oxygen species in photoaging. J Photochem Photobiol B. 1992 Jun 30;14(1-2):105–24.

13. Adityan B., Kumari R., and Thappa DM. Scoring systems in acne. Indian J Dermatol Venereol Leprol. 2009;75(3):323-6.

14. Lolis MS, Bowe WP, and Shalita AR. Acne and systemic disease. *Med Clin North Am* 2009;93:1161–1181.

15. Simpson RC, Grindlay DJ, and Williams HC. What's new in acne? An analysis of systematic reviews and clinically significant trials published in 2010–11. *Clin Exp Dermatol* 2011;36:840–843.

16. Al-Shobaili HA, Alzolibani AA, Al Robaee AA, Meki AR, Rasheed Biochemical markers of oxidative and nitrosative stress in acne vulgaris: correlation with disease activity. J Clin Lab Anal. 2013 Jan;27(1):45-52.

17. Ibrahim MA, Helmy Manal E, Sabry Hanan H, Farouk Suzan M, Ebrahim Lubna Y, and Amer Eman R. Evaluation of biomarkers of the oxidant-antioxidant balance in patients with Acne vulgaris. Journal of the Egyptian Women's Dermatologic Society. 2015 May;12(2):136–41.

18. Al-Shobaili HA. Oxidants and anti-oxidants status in acne vulgaris patients with varying severity. Ann Clin Lab Sci. 2014 Spring;44(2):202-7. PMID 24795060.

19. Sahib AS, AlAnbari H, and Raghif A. Oxidative stress in acne vulgaris: an important therapeutic target. J Mol Pathophysiol. 2013 Apr 1;2(1):27-31.

20. Mahmoud A, Gaber MEW, and Dawood AER. Oxidants and antioxidants play roles in acne vulgaris. Menoufia Med J. 2014 Apr 1;27(2):465.

21. Ragab M, AbouZeid A, Garem Y, Ahmed R. Study of oxidative stress in different clinical severities of acne vulgaris. Egypt J Dermatol Venerol. 2014 Jan 1;34(1):53.
22. Arican O, Kurutas EB, and Sasmaz S. Oxidative stress in patients with acne vulgaris. Mediators Inflamm. 2005 Dec 14;2005(6):380-4.
23. Abdel Fattah NS, Shaheen MA, Ebrahim AA, and El Okda ES. Tissue and blood superoxide dismutase activities and malondialdehyde levels in different clinical severities of acne vulgaris. Br J Dermatol. 2008 Nov;159(5):1086–91.
24. Awad SM, Morsy H, Sayed AA, Mohamed NA, Ezzat GM, and Noaman MM. Oxidative stress and psychiatric morbidity in patients with facial acne. J Cosmet Dermatol. 2018 Apr;17(2):203-8.
25. Moazen M., Mazloom Z., Jowkar F., Nasimi N., and Moein Z. Vitamin D, adiponectin, oxidative stress, lipid profile, and nutrient intakes in females with acne vulgaris: A case-control study. Galen Med J. 2019 Aug 9;8:e1515.
26. Jisha R., Saboora Beegum M., and Yogapriya V. Oxidative Stress in Acne Vulgaris, Vol. 14, Issue 11, 2022.
27. Kardeh S, Moein SA, Namazi MR, and Kardeh B. Evidence for the important role of oxidative stress in the pathogenesis of acne. Galen Med J. 2019 Apr.
28. Al-abadie M, Oumeish M, Al-Rub Aye, Al-abadie M, Oumeish F, Al-rubaye M, Rafiq S, Ball PA, Morrissey H. Vitamin derivatives are used in the treatment of skin conditions. Int J Curr Pharm Res. 2020;12(6, Nov):9–12.