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Original Research

Biochemical Markers of Oxidative Stress in Psoriasis: A Cross-Sectional Study

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Abstract

Background and Objectives: Inflammation and elevated oxidative stress are hallmarks of psoriasis, an inflammatory skin condition that persists over time and is thought to be immune-mediated. Keratinocyte hyperproliferation and disease progression are both impacted by oxidative stress. The purpose of this research was to compare psoriasis patients with healthy controls and assess their levels of certain biochemical markers of oxidative stress. Methods: This cross-sectional study comprised 80 clinically diagnosed psoriasis patients and 40 age- and sex-matched healthy controls. This study was conducted in the Department of Biochemistry, Kamineni Institute of Medical Sciences, Telangana, India, between January 2021 to December 2021. Five milliliters of venous blood were obtained from each participant. Serum concentrations of malondialdehyde (MDA), superoxide dismutase (SOD), catalase (CAT), and reduced glutathione (GSH) were assessed utilizing standard spectrophotometric techniques. The severity of psoriasis was evaluated utilizing the Psoriasis Area and Severity Index (PASI). Statistical analysis utilized Student's t-test and Pearson's correlation coefficient, with $p < 0.05$ being statistically significant. Results: Patients with psoriasis had considerably higher serum MDA levels (5.82 ± 0.94 nmol/mL) than controls (2.96 ± 0.71 nmol/mL; $p < 0.001$). The levels of antioxidant enzymes such as SOD (1.78 ± 0.42 U/mL vs. 3.12 ± 0.55 U/mL), CAT (38.6 ± 6.4 U/mL vs. 61.3 ± 7.1 U/mL), and GSH (3.21 ± 0.63 mg/dL vs. 6.08 ± 0.82 mg/dL) were significantly lower in patients ($p < 0.001$ for all). While antioxidant levels had a substantial negative link with disease severity, a positive correlation was noted between PASI score and MDA levels ($r = 0.64$, $p < 0.01$). Conclusion: The results show that psoriasis patients have increased oxidative stress due to a major imbalance between their oxidant and antioxidant systems. It is possible that impaired antioxidant defenses and increased lipid peroxidation play a role in the development and progression of illness. Keeping an eye on indicators of oxidative stress could help us understand how diseases progress and lay the groundwork for treatments that rely on antioxidants.

Keywords: *Psoriasis; Oxidative stress; Malondialdehyde; Superoxide dismutase; Catalase; Reduced glutathione; PASI score.*

Introduction

Hyperproliferation and aberrant differentiation of keratinocytes cause erythematous, scaly plaques to form in psoriasis, an inflammatory skin illness that is persistent and mediated by the immune system. It has a major influence on people's physical, mental, and social health; it strikes about 2% to 3% of the world's population at any age [1]. Psoriasis is known to be a complex illness with multiple causes, including but not limited to genetic susceptibility, environmental factors, immunological dysregulation, and metabolic changes. However, the specific cause of the disease is still not fully understood [2, 3].

The pathophysiology of psoriasis is heavily influenced by oxidative stress, according to recent studies. When the body's antioxidant defense mechanism is overwhelmed by the creation of reactive oxygen species (ROS), oxidative stress results. Inflammation, keratinocyte hyperproliferation, and immune response amplification can result from ROS damage to cellular lipids, proteins, and DNA. Psoriatic lesions are characterized by elevated reactive oxygen species (ROS) production, which in turn increases lipid peroxidation and cellular damage, due to the involvement of activated neutrophils, macrophages, and T-lymphocytes [4, 5].

An established indicator of lipid peroxidation, malondialdehyde (MDA) shows how much oxidative damage has occurred to cell membranes. The anti-oxidant defense mechanisms rely on enzymes like catalase and superoxide dismutase (SOD) and non-enzymatic antioxidants such reduced glutathione (GSH). Changes in these biochemical indicators may suggest that psoriasis sufferers have reduced antioxidant capacity [6, 7].

Further research is needed due to variances in study populations and techniques, even though multiple studies have found elevated oxidative stress in psoriasis. The disease processes and potential antioxidant-based treatment options can be better understood if we can establish a correlation between oxidative stress markers and illness severity [8, 9].

In considering this, the current investigation set out to examine the relationship between the severity of psoriasis and a number of biochemical indicators of oxidative stress in this patient population.

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Materials and Methods

This cross-sectional study was conducted in the Department of Biochemistry, Kamineni Institute of Medical Sciences, Telangana, India. The study was carried out over a period of January 2021 to December 2021 after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment. The study included 80 clinically diagnosed patients with psoriasis attending the Dermatology outpatient department and 40 age- and sex-matched apparently healthy individuals serving as controls.

Clinical Assessment

A thorough medical history was taken, including details on the patient's symptoms, family medical background, medical treatments, and any co-occurring conditions. The Psoriasis Area and Severity Index (PASI) score was used to evaluate the clinical severity of psoriasis.

Sample Collection

Each subject had about 5 milliliters of their venous blood drawn under strict aseptic circumstances. Before biochemical analysis, blood samples were spun at 3000 rpm for 10 minutes to extract serum, which was then preserved at -20°C.

Inclusion Criteria:

- Patients aged 18-65 years.
- Clinically diagnosed cases of psoriasis confirmed by a dermatologist.
- Patients willing to provide written informed consent.

Exclusion Criteria:

- Patients with other chronic inflammatory or autoimmune disorders.
- Patients with diabetes mellitus, cardiovascular disease, hepatic.
- Patients receiving systemic antioxidant therapy.
- Pregnant or lactating women.
- Individuals with history of smoking or alcohol abuse.

Statistical Analysis:

Data were inputted and analyzed utilizing the Statistical Package for the Social Sciences. Results were presented as mean ± standard deviation (SD). A comparison between psoriasis patients and controls was conducted using Student's unpaired t-test. Pearson's correlation coefficient was employed to evaluate the association between oxidative stress markers and the PASI score. A p-value of less than 0.05 was deemed statistically significant.

Results

The study included 80 individuals, consisting of 40 clinically confirmed psoriasis patients and 40 healthy controls. The biochemical indicators of oxidative stress were compared between the two groups, and their association with illness severity was examined.

Table 1: Demographic Characteristics of Study Participants

Parameter	Psoriasis Patients (n=40)	Controls (n=40)	p-value
Age (years)	42.6 ± 11.3	40.8 ± 10.9	0.46
Male/Female (n)	24/16	22/18	0.64
Duration of Disease (years)	6.8 ± 3.2	–	–
PASI Score	12.4 ± 4.6	–	–

This study's demographic and clinical details are laid out in Table 1. The gender and age distributions of the control group and the psoriasis patients were not significantly different ($p > 0.05$). Indicating moderate disease severity, the average duration of psoriasis was 6.8 ± 3.2 years, and the average PASI score among patients was 12.4 ± 4.6.

Table 2: Comparison of Serum Malondialdehyde (MDA) Levels

Parameter	Psoriasis Patients (n=40)	Controls (n=40)	p-value
MDA (nmol/mL)	5.82 ± 0.94	2.96 ± 0.71	<0.001*

*Statistically significant

Psoriasis patients' serum MDA levels are much higher than healthy controls' ($p < 0.001$), as seen in Table 2. This points to the fact that psoriasis is characterized by elevated oxidative stress and lipid peroxidation.

Table 3: Comparison of Antioxidant Enzyme Levels (SOD and CAT)

Parameter	Psoriasis Patients (n=40)	Controls (n=40)	p-value
SOD (U/mL)	1.78 ± 0.42	3.12 ± 0.55	<0.001*
CAT (U/mL)	38.6 ± 6.4	61.3 ± 7.1	<0.001*

*Statistically significant

The levels of antioxidant enzymes (SOD and CAT) are significantly lower in psoriasis patients when compared to controls ($p < 0.001$), as seen in Table 3. This indicates that affected individuals may have impaired enzymatic antioxidant defense.

Table 4: Comparison of Reduced Glutathione (GSH) Levels

Parameter	Psoriasis Patients (n=40)	Controls (n=40)	p-value
GSH (mg/dL)	3.21 ± 0.63	6.08 ± 0.82	<0.001*

*Statistically significant

The serum reduced glutathione (GSH) levels in psoriasis patients are significantly lower than in controls ($p < 0.001$), according to Table 4, suggesting that the non-enzymatic antioxidant reserves have been depleted.

Table 5: Correlation between Oxidative Stress Markers and PASI Score in Psoriasis Patients

Parameter	Correlation Coefficient (r)	p-value
MDA vs PASI	+0.64	<0.01*
SOD vs PASI	−0.58	<0.01*
CAT vs PASI	−0.61	<0.01*
GSH vs PASI	−0.55	<0.01*

*Statistically significant

Lipid peroxidation increases as disease severity increases, as shown by the significant positive connection between MDA levels and PASI score ($r = 0.64$), as shown in Table 5. On the other hand, there were strong negative relationships between PASI score and antioxidant markers (SOD, CAT, and GSH), indicating that antioxidant defenses are impaired in severely ill patients.

Discussion

In this work, we assessed the levels of several oxidative stress markers in psoriasis patients and contrasted them with healthy controls. The results showed that serum malondialdehyde (MDA) levels rose significantly while antioxidant defenses such superoxide dismutase (SOD), catalase (CAT), and reduced glutathione (GSH) fell significantly. Also, oxidative stress markers were strongly linked to the severity of the disease as measured by PASI score. This suggests that there is a substantial link between oxidative imbalance and the advancement of psoriasis [10-12].

In this study, the markedly raised MDA levels in psoriasis patients signify heightened lipid peroxidation and an increased production of reactive oxygen species (ROS). MDA is a well-known byproduct of the oxidation of polyunsaturated fatty acids and is a good way to tell if the membrane has been damaged by oxidative stress. The elevated MDA levels detected in our patients may be ascribed to the excessive formation of reactive oxygen species (ROS) by activated neutrophils, macrophages, and T-lymphocytes within psoriatic lesions. This oxidative damage may exacerbate inflammatory pathways and keratinocyte hyperproliferation, ultimately facilitating disease development [13-15].

Compared to controls, psoriasis patients had far lower levels of the antioxidant enzymes SOD and CAT in this study. SOD is very important for turning superoxide radicals into hydrogen peroxide, which CAT then breaks down into water and oxygen. A reduction in these enzymatic antioxidants indicates compromised detoxification of reactive oxygen species (ROS), resulting in the buildup of oxidative intermediates. The loss of these enzymes may be because they are used too much to fight against oxidative stress that doesn't go away [16-18].

This study found that psoriasis patients have far lower levels of reduced glutathione (GSH), which is an important non-enzymatic antioxidant. GSH is very important for keeping the redox equilibrium in cells and getting rid of reactive intermediates. Its depletion shows that the intracellular antioxidant capacity is low, which may make keratinocytes more likely to be damaged by oxidative stress and apoptosis [19, 20]. In this study, there was a positive link between MDA levels and PASI score, while antioxidant markers were strongly linked to less severe illness. These results suggest that oxidative stress escalates with the worsening clinical severity of psoriasis. This substantiates the notion that oxidative imbalance is not solely a result but may actively facilitate disease progression [21].

In the previous study, multiple researchers indicated increased lipid peroxidation and reduced antioxidant enzyme activity in psoriasis patients, which corresponds with our results. Previous studies have indicated that chronic inflammation in psoriasis induces sustained reactive oxygen species (ROS) production, leading to oxidative tissue injury and systemic involvement. Some research have also shown a direct link between oxidative stress markers and PASI score, which supports the idea that oxidative imbalance makes diseases worse [22].

The previous study suggested that oxidative stress could activate redox-sensitive transcription factors like NF-κB, which would then lead to the release of pro-inflammatory cytokines like TNF-α, IL-6, and IL-17. This sets off a loop in which inflammation causes oxidative stress, which in turn keeps inflammation going. Our findings align with this suggested mechanism [23, 24].

Conclusion

This study shows that psoriasis sufferers have a considerable oxidant-antioxidant imbalance. High serum malondialdehyde (MDA) levels indicate increased lipid peroxidation and oxidative stress, while low antioxidant markers like SOD, CAT, and GSH indicate compromised antioxidant defense mechanisms. Oxidative stress appears to be linked to psoriasis progression due to the positive connection between MDA levels and PASI score and the negative correlation between antioxidant indicators and disease severity. These data suggest oxidative imbalance's significance in illness etiology and severity. Therefore, oxidative stress markers may help comprehend disease activity. To determine the therapeutic potential of antioxidant-based therapies for psoriasis, larger studies with longitudinal follow-up are needed.

Funding
None
Conflict of Interest:
None

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