Dermatology Practical & Conceptual

Elevated Serum Levels of Osteopontin in Patients with Psoriasis: Is It Associated with Ocular Comorbidities?

Hala M. Elsadek[1], Radwa O. M. Kamel[1], Marwa Abdallah Elsaid[2], Rasha Muhammad Rashed[3], Mona S. Ali[1]

1 Department of Dermatology and Venereology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt
2 Department of Clinical Pathology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt
3 Department of Ophthalmology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt

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Corresponding Author: Hala M. Elsadek, Department of Dermatology and Venereology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt. Tel: +201272243237 E-mail: HalaMohammed.5323@azhar.edu.eg

ABSTRACT

Introduction: Psoriasis is a chronic inflammatory disease affecting 2-3% of the global population via immune-mediated mechanisms. Osteopontin plays a crucial role in T-helper 1- and T-helper 17-mediated illnesses, including psoriasis. Ocular complications in psoriasis have been reported, and their assessment is of significant importance. Osteopontin is normally expressed constitutively in ocular structures and is linked to ocular homeostasis.

Objectives: The study aimed to clarify the role of osteopontin (OPN) in psoriasis (PS) and its correlation with disease severity and ocular manifestations.

Methods: A case-control study involving 40 psoriatic patients and an equal number of age- and sex-matched healthy subjects was conducted. We used the psoriasis area severity index (PASI) to assess disease severity and performed a comprehensive ophthalmological examination. Additionally, we measured serum osteopontin levels using enzyme-linked immunosorbent assay (ELISA) in both groups.

Results: A significant elevation in serum OPN levels in psoriatic patients compared to controls was found (P= 0.000). Furthermore, there was a highly significant positive correlation between serum OPN levels and patient age, disease duration, and PASI scores. Notably, a higher prevalence of ocular

complications, including blepharitis, corneal affection, conjunctivitis, keratoconjunctivitis sicca, and cataract was observed in psoriatic patients compared to controls. Importantly, significant associations between serum OPN levels and the presence of cataracts and intraocular pressure (IOP) were identified. Additionally, significant correlations between serum OPN levels and measures of visual acuity and ocular surface health were found.

Conclusions: Osteopontin is considered a marker of psoriasis severity and is associated with ocular comorbidities in psoriasis.

Introduction

Psoriasis (PS) is an inflammatory disease of chronic nature characterized by hyperproliferation of keratinocytes in the epidermis, influenced by environmental, genetic, and immunologic factors. It typically affects the skin of the elbows, knees, scalp, lumbosacral areas, and joints in up to 30% of patients. PS affects 2–3% of the worldwide population due to immune-mediated mechanisms (1). A variety of comorbidities are linked to PS, such as psoriatic arthritis, diabetes mellitus, depression, osteoporosis, cardiovascular disease, autoimmune eye disease, metabolic syndrome, fatty liver disease, fibromyalgia, and rheumatic disorders (2).

PS is associated with various extracutaneous symptoms, with eye involvement being a significant aspect and occurring later. PS may affect the eye lid, cornea or conjunctiva, or retina leading to the development of ocular manifestations, including dry eyes, conjunctivitis, blepharitis, keratitis, trichiasis, ectropion, and corneal melting, uveitis, cataract, glaucoma and retinal micro-vascular abnormalities (3).

Diagnosis of PS is determined by clinical features, dermoscopy or histopathology in uncertain cases (4). Recently introduced, line-field confocal optical coherence tomography (LC-OCT), a non-invasive tool, offers high-resolution images of psoriatic lesion in vivo, potentially improving diagnosis, biopsy guidance, treatment monitoring, and disease severity evaluation (5).

Osteopontin (OPN) is an acid glycoprotein that is expressed by various immune cells during inflammation, including macrophages, natural killer cells, dendritic cells, B and T cells, and vascular smooth muscle cells. Moreover, OPN has been reported as a Th1 cytokine implicated in monocyte/macrophage activation, migration, inflammation, cell-mediated immunity, cell survival, mediated by binding to cluster of differentiation (CD44), metastases, and tumor invasion and plays a crucial role in cell adhesion (6).

It has been shown that OPN is involved in both acute and chronic inflammatory processes. OPN is mostly released at the site of inflammation by T cells and activated macrophages (7).

OPN is expressed in retinal ganglionic cells (RGCs), Muller cells, and retinal pigment epithelium. Functionally, OPN is involved in corneal tissue regeneration and persistence of RGCs against ischemic injury. OPN is associated with ocular homeostasis under normal conditions (8).

Objectives: This study was conducted to measure the serum levels of OPN in PS patients and to correlate it with disease severity and ocular comorbidity to assess its possible role in the disease pathogenesis.

Methods

Study Design and Setting

This case-control study was conducted at XXX University Hospital, Dermatology and Venereology Department, in collaboration with the ophthalmology department affiliated with the Faculty of Medicine XXXXXX from February to October 2023. The subjects provided written, informed consent before their participation in the study. The study was approved by the Research Ethics Committee of the Faculty of Medicine, Al-Azhar University (reference number RHDIRB 2022121668).

Study Size

Sample size was calculated using G power 3.1.9.4 depending on data from previous studies that studied the association between osteopontin and eye changes in alopecia areata as no previous research on the association between osteopontin and eye changes in psoriasis, depending on correlation between osteopontin and fundus changes = 0.4 accordingly the required sample size was 40 participant in each group.

Participants

The study involved 80 participants attending the outpatient clinic of the Dermatology and Venereology Department, divided into two groups: 40 patients with PS diagnosed clinically or histopathologically, and 40 age- and sex-matched healthy subjects as the control group. Patients of both sexes, aged 20-60 years without prior systemic therapy for at least 4-6 weeks or prior topical medication for PS for at least two

weeks, were included. Exclusion criteria included patients with other dermatological and/or systemic autoimmune diseases, patients with cutaneous malignancies, and those with ocular diseases. Patients diagnosed with pneumonia, hepatic or renal failure, urinary tract infection, and systemic disorders likely to show ocular involvement such as diabetes mellitus and hypertension were also excluded.

Data Collection

All participants underwent a comprehensive history taking, followed by:

1. Dermatological examination, including clinical evaluations of skin, nails, hair, and mucous membranes. The severity of PS was calculated according to PS area and severity index (PASI) score. Accordingly, patients were classified as having mild PS (PASI <10), moderate PS (PASI 10-20), or severe PS (PASI >20) (9).
2. Ocular examinations, including assessment of visual acuity (VA) and best corrected visual acuity (BCVA), and slit lamp examination of anterior segment (lid, lacrimal opening, conjunctiva, cornea, anterior chamber depth and content, iris and lens) using Topcon slit lamp (Japan). Intraocular pressure was measured using Goldmann applanation tonometer, and dilated fundus examination (using mydriatic eye drops prior to the examination) using +90 D volk aspheric lens. The corneal fluorescein staining, Schirmer (after topical anesthesia), and TBUT tests were performed.

Laboratory Investigations

Sample Collection and Preparation

About 3 ml of venous blood were collected from each individual and centrifuged at 3000 rpm for 20 min; then serum was collected and stored at –60°C for measuring serum OPN by enzyme-linked immunosorbent assay (ELISA).

Measurement of OPN Serum Levels

The concentration of OPN level in serum was analyzed following the manufacturer's instructions. Measurements were done by quantitative sandwich ELISA technique using an ELISA reader (das 1851) and human OPN ELISA kit (Catalog number: E1525hu) (Bioassay Technology Laboratory, China).

Statistical Analysis

Data were analyzed by the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data are presented as mean, standard deviations (SD), and ranges in case of parametric data and median, inter-quartile range (IQR) when data were non-parametric. Instead, qualitative variables are presented as numbers and percentages: Chi-square test was used to compare qualitative data between groups. Comparing two independent groups with quantitative data and parametric distribution was performed by using Independent t-test, while data with non-parametric distribution was compared using Mann-Whitney test.

The correlation between two quantitative variables in the same group was assessed by Spearman's correlation coefficient. Receiver operating characteristic curve (ROC) was used to determine the best cutoff point with its specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV), and area under curve (AUC) of OPN level to differentiate between the two studied groups. The *P* value was considered significant when the value is less than 0.05.

Results

A total of 40 psoriatic patients included 23 (57.5%) females and 17 (42.5%) males. Their ages ranged from 22 to 60 years, with a mean of 40.15 ± 9.26. A similar number of healthy individuals as controls included 28 (70%) females and 12 (30%) males, age range 20–60 years, with a mean of 40.25 ± 12.16 years without a statistically significant difference. The PS duration ranged from 2 to 23 years, with a mean of 11.18 ± 6.29. PS severity was assessed by PASI score ranging from 9 to 26, with mild-to-moderate disease in 28 cases (70.0%) and severe disease in 12 cases (30.0%), as shown in Table 1.

Regarding serum OPN, psoriatic cases showed a statistically significantly higher level compared to controls ($P = 0.000$). Based on the ocular findings of both eyes in the studied groups, anterior and posterior blepharitis, corneal affection, conjunctivitis, keratoconjunctivitis sicca, and cataract were significantly more frequent among patients than controls ($P<0.05$). Neither group showed uveitis or fundus abnormalities (Table 2).

A receiver operating characteristic (ROC) curve was conducted for serum levels of OPN to discriminate between patients and controls. At a cutoff value >20.7, the OPN level showed 100% sensitivity and specificity (Figure 1).

There was a highly statistically significant positive correlation between serum OPN levels in patients and their ages, disease duration, and PASI score (r= 0.467, 0.773 and 0.966, P=0.002 and P=0.000, respectively) (Figure 2 A, B and C).

Concerning ocular surface tests, the mean BCVA, BUT, and Schirmer tests were statistically significantly lower in cases compared to controls. The mean IOP value showed no significant differences in cases and controls and was within the normal range (Table 3).

Regarding the relationship between OPN levels and disease severity as well as ocular changes in psoriatic patients,

Table 1. Demographic Data of the Study Groups and Clinical Characteristics of the Patient group.

Items		Patients group (N= 40)	Controls group (N= 40)	Test value	P-value	Sig.
Age	Mean ± SD	40.15 ± 9.26	40.25 ± 12.16	0.041•	0.967	NS
	Range	22 – 60	20 – 60			
Sex	Females	23 (57.5%)	28 (70.0%)	1.352*	0.245	NS
	Males	17 (42.5%)	12 (30.0%)			
Duration of disease (years)	Mean ± SD	11.18 ± 6.29	-	NA	NA	NA
	Range	2 – 23	-			
PASI	Median (IQR)	19 (16–22)	-	NA	NA	NA
	Range	9 – 26	-			
	Mild/moderate	28 (70.0%)	-			
	Severe	12 (30.0%)	-			

Abbreviations: NS: Non-significant; S: Significant, HS: Highly significant. *: Chi-square test; ●: Independent t-test, PASI: psoriasis area severity index, IQR: interquartile.

Table 2. Comparison of Serum Levels of Osteopontin and Ocular Comorbidities between the Two Study Groups.

	Items		Patient group (N= 40)	Control group (N= 40)	Test value	P-value	Sig.
OPN Level	**OPN**	Mean±SD	80.2 ± 40.54	8.38 ± 6.63	-11.058●	0.000	HS
		Range	26.5 – 182.3	0 – 20.7			
	OPN Classification	Normal High	0 (0.0%) 40 (100.0%)	38 (95.0%) 2 (5.0%)	72.381*	0.000	HS
Ocular comorbidities	**Posterior blepharitis**	No	13 (32.5%)	28 (70.0%)	11.257*	0.001	
		Yes	27 (67.5%)	12 (30.0%)			
		Unilateral	6 (22.2%)	6 (50.0%)	3.009	0.083	
		Bilateral	21 (77.8%)	6 (50.0%)			
	Anterior blepharitis	No	21 (52.5%)	32 (80.0%)	6.765*	0.009	
		Yes	19 (47.5%)	8 (20.0%)			
		Unilateral	7 (36.8%)	3 (37.5%)	0.001	0.974	
		Bilateral	12 (63.2%)	5 (62.5%)			
	Cornea affections	No	30 (75.0%)	40 (100.0%)	11.429*	0.001	
		P.E.E.	10 (25.0%)	0 (0.0%)			
	Conjunctivitis	No	13 (32.5%)	34 (85.0%)	24.590*	0.000	
		Hyperemic	25 (62.5%)	4 (10.0%)			
		Pinguecula	2 (5.0%)	2 (5.0%)			
	Keratoconjunctivitis sicca	No	5 (12.5%)	37 (92.5%)	51.328*	0.000	
		Yes	35 (87.5%)	3 (7.5%)			
		Unilateral	16 (45.7%)	0 (0.0%)	2.369	0.124	
		Bilateral	19 (54.3%)	3 (100.0%)			
	Cataract	No	16 (40.0%)	28 (70.0%)	7.273	0.007	
		Present	24 (60.0%)	12 (30.0%)			
		Unilateral	3 (12.5%)	4 (33.3%)	2.217	0.137	
		Bilateral	21 (87.5%)	8 (66.7%)			

Abbreviations: HS: Highly significant, OPN: osteopontin; *: Chi-square test; ●: Independent t-test.

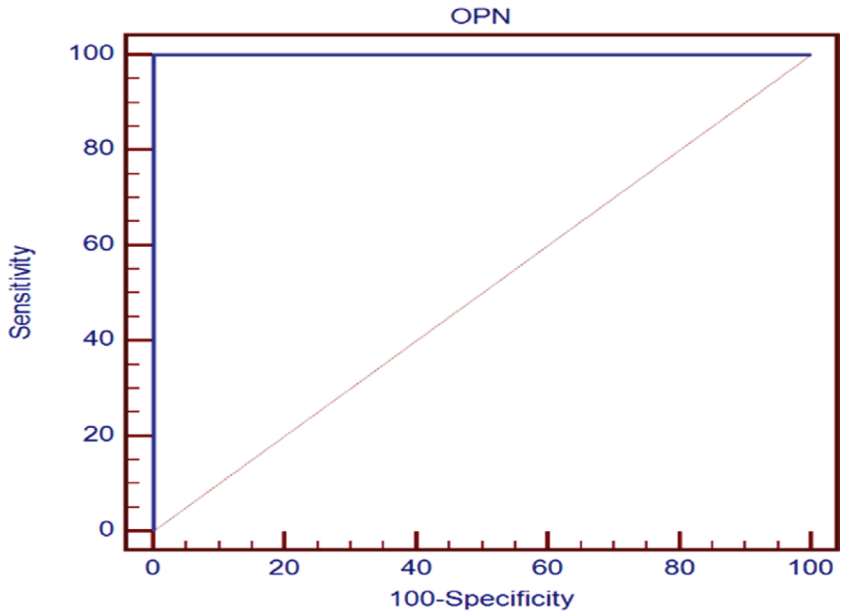

Figure 1. ROC curve for OPN level to differentiate between the two study groups.

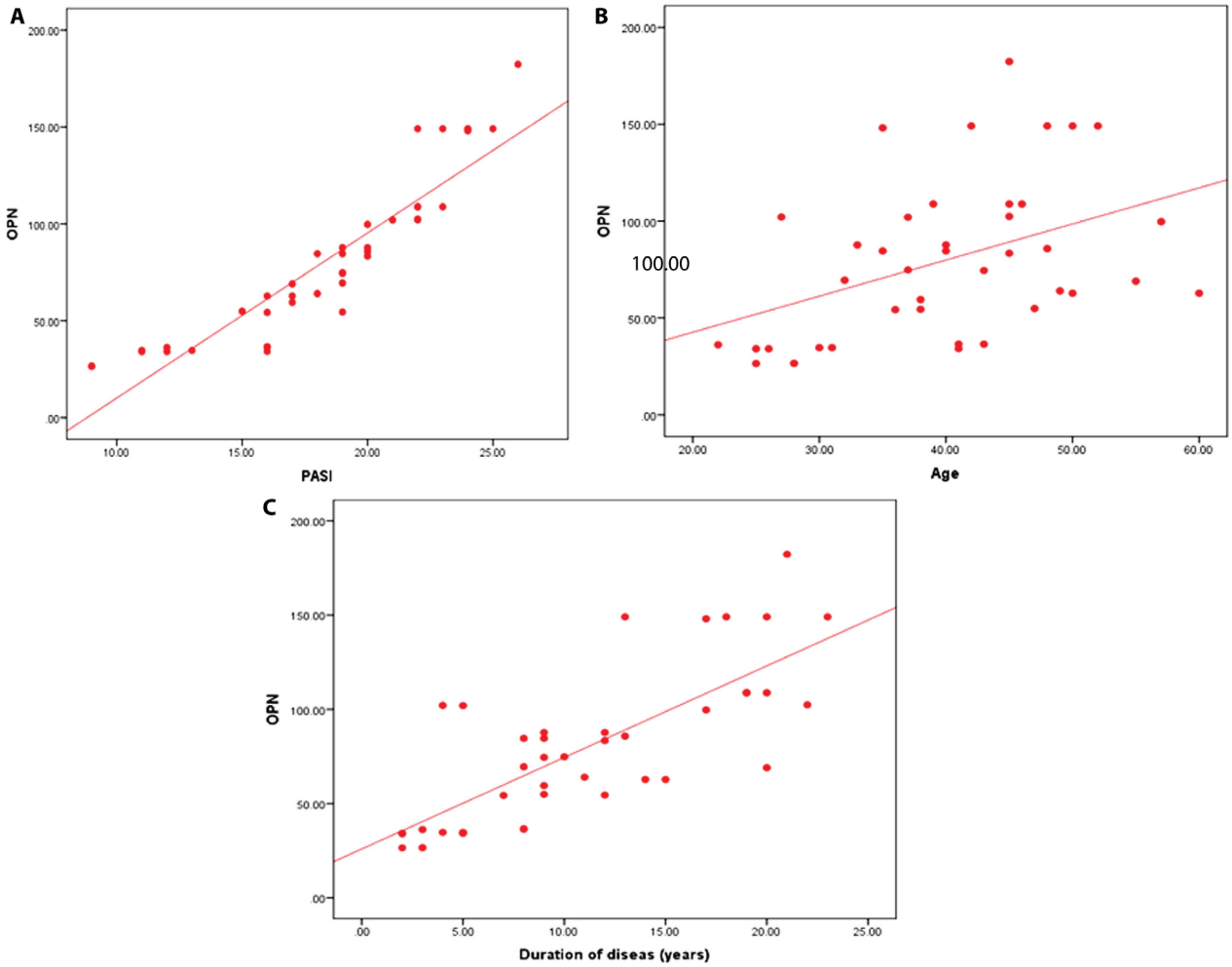

Figure 2. Correlation between osteopontin level and PASI (A), age of patients (B), and duration of disease (C).

Table 3. Comparison of Ocular Surface Tests and IOP between the Two Study Groups.

	Patient group (N=40)	Control group (N=40)	Test value	P-value	
BCVA					
Right eye	Mean ± SD	0.62 ± 0.20	0.91 ± 0.14	7.220•	0.000
	Range	0.32 – 1	0.5 – 1		
Left eye	Mean ± SD	0.70 ± 0.22	0.85 ± 0.21	3.106•	0.003
	Range	0.32 – 1	0.32 – 1		
TBUT					
Right eye	Mean ± SD	8.43 ± 1.68	12.80 ± 2.57	9.006•	0.000
	Range	5 – 11	9 – 18		
Left eye	Mean ± SD	8.60 ± 1.57	10.10 ± 1.60	4.240•	0.000
	Range	5 – 11	6 – 13		
Schirmer test					
Right eye	Mean ± SD	10.60 ± 2.58	12.30 ± 1.90	3.357•	0.001
	Range	5 – 15	9 – 15		
Left eye	Mean ± SD	10.00 ± 2.71	12.00 ± 1.87	3.845•	0.000
	Range	4 – 14	8 – 15		
IOP					
Right eye	Mean ± SD	15.40 ± 3.33	14.90 ± 1.46	-0.868•	0.388
	Range	12 – 25	12 – 18		
Left eye	Mean ± SD	15.55 ± 2.62	15.00 ± 1.50	-1.151•	0.253
	Range	12 – 23	12 – 18		

Chi-square test; * P-value < 0.05; ** P-value < 0.01. Abbreviations: P.E.E: Punctate Epithelial Erosions; BCVA: Best Corrected Visual Acuity, SD: Standard Deviation, BUT: Tear break-up time; IOP: Intraocular pressure; •: Independent t-test.

cases with severe psoriasis showed significantly higher OPN levels compared to mild and moderate cases. Also, cases affected with cataract and those with high IOP showed a significantly higher OPN level compared to cases without these findings (*P*=0.018 and 0.013, respectively), but no statistically significant relations were found with other ocular findings (*P*>0.05). Also, higher OPN levels were associated significantly with lower values of both Schirmer and TBUT tests (*P*=0.001 and P=0.003, respectively) (Table 4).

There was a significant negative correlation between serum OPN levels and BCVA, Schirmer, and BUT tests (r=-0.521, *P*=0.000, r=-0.359, *P*=0.001, and r=-0.737, *P*=0.000, respectively), while a significant positive correlation was present between serum OPN level and IOP (r=0.281, *P*=0.012) (Table 5).

Conclusions

Psoriasis may be linked to an inflammatory response in the eyes. These conditions include defects of the lens, uvea, sclera, cornea, and conjunctiva (10). OPN, through its pro-inflammatory and angiogenic effects, may play a key role in the pathophysiology of PS by helping to cause chronic inflammation and consequently the emergence of concomitant conditions, including ocular comorbidities (11). OPN is linked to severity of psoriasis and is regulated by its expression by lesional keratinocytes, inflammatory cells, and endothelial cells (12).

Serum Osteopontin in Psoriasis Patients

In this study, we observed a statistically significantly higher level of OPN in psoriatic patients compared to healthy controls. In addition, the ROC curve showed that OPN level can be used to differentiate between patients and healthy controls with high specificity and sensitivity. These findings were consistent with earlier research studies (10, 13) that found significantly higher levels of OPN in psoriasis patients' serum and/or skin lesions. Additionally, Przepiórka-Kosińska et al. (11) found that OPN concentrations in psoriatic patients were substantially higher than in healthy volunteers. This can be explained by the notion that OPN promotes epidermal proliferation by blocking keratinocyte death and stimulates vascular formation, which in turn facilitates the influx of inflammatory cells into the skin (14).

The pathophysiology of psoriatic lesions also exhibits similar immunological processes, which raises the possibility that OPN plays a role in the emergence of systemic and local inflammation in PS (11).

Table 4. Relation between OPN Levels and Sex, Disease Severity, and Ocular Changes in Psoriatic Patients.

		OPN		Test value	P-value	Sig.
		Mean ± SD	Range			
Sex	Females	74.8 ± 33.36	26.5 – 149.1	0.979•	0.334	NS
	Males	87.5 ± 48.75	34.1 – 182.3			
Severity of disease	Mild/moderate	58.86 ± 22.29	26.5 – 99.7	42.737•	<0.001	HS
	Severe	129.98 ± 27.29	102 – 182.3			
Posterior blepharitis	No	90.63 ± 42.83	34.2 – 149.1	1.134•	0.264	NS
	Yes	75.17 ± 39.21	26.5 – 182.3			
Anterior blepharitis	No	78.82 ± 42.05	26.5 – 182.3	-0.223•	0.825	NS
	Yes	81.72 ± 39.89	34.1 – 149.1			
Corneal affection	No	76.69 ± 39.35	26.5 – 182.3	-0.947•	0.35	NS
	P.E.E.	90.72 ± 44.35	34.7 – 149.1			
Keratoconjunctivitis sicca	No	77.64 ± 52.07	26.5 – 148.1	-0.149•	0.882	NS
	Yes	80.56 ± 39.56	34.1 – 182.3			
Cataract	No	61.97 ± 32.98	26.5 – 149.1	2.469	0.018	S
	Yes	92.35 ± 41.13	34.1 – 182.3			
IOP	Normal	74.99 ± 38.71	26.5 – 182.3	2.616•	0.013	S
	High	127.1 ± 24.97	102.4 – 149.1			
Schirmer test	<15(dryness)	165.7 ± 23.48	149.1 – 182.3	3.466•	0.001	HS
	>15(normal)	75.7 ± 36.07	26.5 – 149.1			
TBUT	<10	107.98 ± 43.93	26.6 – 182.3	3.145•	0.003	HS
	>10	68.29 ± 33.13	26.5 – 149.1			

Abbreviations: NS: Non-significant; S: Significant; HS: Highly significant; OPN= osteopontin; P.E.E: Punctate Epithelial Erosions; BCVA: Best Corrected Visual Acuity, SD: Standard Deviation, TBUT: Tear break-up time; IOP: Intraocular pressure. •: Independent t-test; ≠: One Way ANOVA test.

Table 5. Correlation of OPN level with BCVA, IOP, Schirmer, and BUT Tests in Patients with PS.

	OPN	
Patient group	R	P-value
BCVA	-0.521**	0.000
IOP	0.281*	0.012
Schirmer test	-0.359**	0.001
BUT	-0.737**	0.000

Abbreviations: BCVA: Best Corrected Visual Acuity; IOP: Intraocular pressure; BUT: Tear break-up time.

In contrast to our study, Kılınç et al. (15) reported no significant variations in OPN level between the control and PS groups.

Correlations between Serum OPN and Disease Severity and Demographic Factors

The current study revealed a significant positive correlation between OPN serum levels and PASI score in patients, with severe cases exhibiting higher levels compared to mild and moderate cases. Our findings are consistent with those of Kadry et al. (16), who reported a favorable relationship between the clinical severity of PS and plasma OPN level, and Abdel-Mawla et al. (17), who reported a significant correlation between OPN expression in the epidermis, dermal inflammatory infiltrate of lesional psoriatic skin, and PASI score. This can be explained by OPN's role in several Th1- and Th 17-mediated diseases including PS, via several mechanisms that share in PS onset and worsening. Conversely, it has been shown that there is no correlation between the existence of OPN and psoriatic arthritis and PASI score in psoriatic patients (13, 18).

Furthermore, a highly significant positive correlation was observed between the serum level of OPN and both the duration of the disease and the age of patients. This result is consistent with the findings of Abdel-Mawla et al. (17), who found a significant association between the duration of the disease and OPN tissue expression. In contrast, the serum level of OPN is not related to disease duration (18).

The ocular Findings of both Studied Groups

A previous study (19) reported an association of ocular findings with PS. In the present study, patients with PS showed

significant ocular changes compared to controls. Ocular affections in the patient group included anterior blepharitis (47.5%), posterior blepharitis (67.5%), punctate epithelial erosions (25.0%), conjunctivitis (67.5%), keratoconjunctivitis sicca (87.5%), and cataract (60.0%). Our findings are consistent with those reported in previous case-control studies (20-22), which reported a higher prevalence of ocular changes in psoriatic patients compared to healthy individuals.

Ocular comorbidities in PS may be influenced by various etiopathogenetic mechanisms, including direct ocular involvement with psoriatic plaques, immune-mediated inflammatory conditions, and side effects of treatments such as phototherapy, methotrexate, biologics, and oral retinoids (21, 23). Furthermore, due to similar immune system dysregulation and inflammation, psoriasis is more likely associated with diabetes and hypertension, which may contribute to ocular abnormalities (24). Nevertheless, none of these explanations was included in our analysis.

Keratoconjunctivitis sicca (dry eye syndrome), blepharitis, and conjunctivitis were the most common ocular affections in psoriatic patients in our study. This is in line with the earlier research (20) findings, where the most common ocular abnormalities in psoriatic patients were dry eye and blepharitis.

Psoriatic patients experience dry eye syndrome as a result of meibomian gland dysfunction. The glandular ducts' epithelial keratinization is the cause of the malfunction (21).

The TBUT and Schirmer tests are two commonly used diagnostic procedures for dry eye disease (DED). In the present study, the mean values of both tests in both eyes were significantly lower than values in controls. Similarly, previous studies (20, 22) detected a decrease in the mean values of TBUT and Schirmer tests in psoriatic patients, denoting tear film instability and eye dryness. The meibomian glands provide a lipid component that is crucial to the integrity of the tear film. DED may have occurred due to PS-related meibomian gland dysfunction, resulting in tear evaporation, or due to increase tear osmolarity from inflammation in psoriasis or lacrimal duct blockage (20).

Since PS is primarily an epithelial disease, one of the main sites of ocular involvement is the eyelids (25). We reported anterior and posterior blepharitis in 47.5% and 67.5% of psoriatic patients, respectively. Like our results, Erbagci et al. (26) showed a 65% prevalence of blepharitis in PS patients. Blepharitis is a common prevalent ocular finding in psoriatic patients (22).

Posterior blepharitis was reported more frequently in our patients denoting meibomian gland dysfunction, which may be related to occlusion of meibomian duct by psoriatic scale (25). Furthermore, a prior study has documented a variation in the consistency of secretions from the meibomian gland, which are thicker in nature in psoriatic patients. This variation may lead to stagnation and to meibomian gland ducts blockage (27).

Regarding lens abnormalities reported in our study, 60.0% of patients developed cataract. Previous research has shown that patients with psoriasis may develop cataract (22, 28). Because light with wavelengths between 300 and 400 nm is absorbed in the lens and may result in photochemical alterations in the lens proteins, ultraviolet radiation may play a role in the development of cataracts. PS treatment using psoralen-UVA has been suggested to cause anterior cataracts (28).

Kilic et al. (20) reported corneal affections including punctate epithelial erosion, corneal opacity, and vascularization in 16/100 of psoriatic patients. Similarly, we reported punctate epithelial keratitis in 25.0% of patients with psoriasis. After multivariate correction with many risk variables, psoriasis may be a distinct risk factor for keratopathy in patients without a history of severe corneal illness. Furthermore, dry eye disease raised the possibility of keratopathy in psoriasis (29).

Hyperemic conjunctivitis was reported in 62.5% patients in the present study, which agrees with previously published articles, which reported a high prevalence rate of conjunctivitis in psoriasis (64.5%) (30).

In the present study, psoriatic patients showed significantly lower mean BCVA in both eyes than in controls with mild visual impairment. Similar to our observation, minimum impairment of vision in psoriatic patients has been observed (31), while Kharolia et al. (19) did not find any visual impairment.

In the current study, the mean IOP in psoriatic patients did not differ significantly from IOP in controls and was within the normal range. Also, we did not record any uveitis or retinal abnormalities.

Relationship between OPN Levels and Ocular Changes in Psoriatic Patients

Our findings revealed significantly higher OPN levels in cases with cataract and in cases with high IOP than in cases without these findings. However, no significant relationships were found with other ocular findings. OPN modulates corneal healing and neovascularization and controls lens epithelial-mesenchymal transition in mice. It is upregulated in rat retinal ganglionic cells in response to excitotoxic and ischemic injury (32).

It has been reported that OPN is present in the extracellular matrix in anterior subcapsular cataract and human postoperative capsular opacification (33). Mouse lens epithelial cells express OPN ectopically in response to capsular injury, suggesting a potential role in maintaining healthy trabecular meshwork by inhibiting calcification and promoting

a healthy meshwork. (34). In addition, OPN has been identified as one of the most abundant proteins in human aqueous humor (35).

Correlation between OPN levels and ocular surface tests and IOP in psoriatic patients

Our results showed significantly higher OPN levels, which were associated with lower values of both the Schirmer and TBUT tests. In addition to a significant negative correlation between serum OPN levels and BCVA, Schirmer, and BUT tests. While significant positive correlation was present between serum OPN level and IOP. This may be attributed to the crosstalk between OPN and oxidative stress involved in the pathogenesis of several eye diseases, including senile cataract, uveitis, age-related macular degeneration, keratitis, ocular inflammation, and premature retinopathy (36).

The study's main limitations include a small sample size and the inability to detect tissue osteopontin expression, crucial for assessing disease progression, especially ocular abnormalities.

We would like to highlight that psoriatic patients have elevated osteopontin levels, correlated with PASI score, suggesting that this indicates PS severity and pathophysiology. The study suggests that osteopontin may contribute to ocular alterations in psoriasis. Ocular comorbidities are common in psoriatic patients, and close follow-up is recommended for early-onset cataracts and high IOP. Larger-scale studies are needed to understand the impact of osteopontin on the eyes of psoriatic patients.

Ethical Approval: The study approved by the Research Ethics Committee of the Faculty of Medicine, Al-Azhar University (reference number RHDIRB 2022121668). Additionally, it fulfilled all the ethical aspects necessary in human research.

Patient Consent for Publication: Prior to their involvement in the study, the subjects provided written, informed consent.

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