Dermatology Practical & Conceptual

Ultraviolet-induced Fluorescence Patterns in Psoriasis: Insights from a Large International Cohort Study

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ABSTRACT

Introduction: Psoriasis is a common skin disease displaying a broad spectrum of clinical presentations that can sometimes pose diagnostic challenges. UV-induced fluorescence dermatoscopy (UVFD) is a novel dermatoscopy mode useful as a complementary diagnostic method in inflammatory dermatoses. The understanding of red fluorescence in psoriasis, caused by protoporphyrin IX, in regard to clinical-morphological features, site-dependency, geographic variability, and bleaching with sun-exposure remains very limited.

Objective: The study objective was to explore fluorescence patterns in relation to demographic and geographic factors, disease subtype, lesion morphology, Psoriasis Area and Severity Index (PASI) score, seasonal variations, and bathing practices.
Method: This study included 356 UVFD images from 111 psoriatic patients naive to the treatment from Central and Southern Europe and explored fluorescence patterns in relation to demographic and geographic factors, disease subtype, lesion morphology, Psoriasis Area and Severity Index (PASI) score, seasonal variations, and bathing practices. For the statistical analysis we have employed a series of Chi-squared tests for independence and independent samples t-tests.
Results: Red fluorescence was predominantly observed in subtypes affecting sun-protected areas in patients with higher PASI scores, especially erythema and induration. Geographic and seasonal variability was observed, while age, sex, and bathing practices did not significantly affect fluorescence patterns.
Conclusion: The study confirms that red fluorescence in psoriatic lesions under UVFD is suppressed by sun exposure and correlates with disease severity.

Introduction

Psoriasis is a common skin disease displaying a broad spectrum of clinical presentations that can sometimes pose diagnostic challenges. Given its incidence across all age groups and its manifestation in cosmetically sensitive areas, the disease imposes a significant psychological and socioeconomic burden on affected individuals worldwide. Dermatoscopy serves as a non-invasive auxiliary diagnostic tool that aids in the diagnostic process of common dermatoses, thereby improving diagnostic accuracy and clinician's confidence [1–3]. Ultraviolet-induced fluorescence dermatoscopy (UVFD) is a novel dermatoscopic mode applicable to neoplastic, inflammatory, infectious, and parasitic conditions [4–7]. This imaging method utilizes the Stokes shift. In this phenomenon, ultraviolet (UV) light emitted by the diodes induces fluorescence in the fluorophore (emission of light characterized by a longer wavelength and lower energy than the excitation light) [4]. A small portion of reflected UV light is filtered out by the dermatoscope UV filters, which allow only the visible light spectrum to pass through. A distinctive peripapillary red fluorescence exhibited under UVFD in certain psoriatic lesions is attributed to the accumulation of protoporphyrin IX in the stratum corneum, particularly in more severe cases [8,9]. The understanding of red fluorescence in psoriasis in regard to clinical-morphological features, site-dependency, geographic variability, and bleaching with sun exposure remains very limited. Moreover, it has been speculated that some fluorophores may either be washed away with water or diminish following sun exposure [4,9,10].

Objectives

The study objective was to explore the patterns of UVFD in relation to demographic factors, psoriasis subtype, anatomical distribution of the lesions, Psoriasis Area and Severity Index (PASI) score, geographic region, seasonal variations, and bathing practices on the day of examination.

Methods

In this retrospective international cohort study, performed between January 2023 and March 2024, we explored the patterns of UVFD in relation to the demographic factors, psoriasis subtype, anatomical distribution of the lesions, Psoriasis Area and Severity Index (PASI) score, erythema, induration, and desquamation scores of particular lesions (0–3), geographic region (Central Europe: Poland, Ukraine; Southern Europe: Italy, North Macedonia), seasonal variations (winter, spring, summer, autumn), and bathing practices on the day of examination (yes/no). In the study group, we included patients diagnosed clinically and/or histologically with psoriasis who had received no targeted treatment for psoriasis in the six weeks before their examination and who did not have any overlapping dermatoses. A hybrid (conventional/UVFD) DL5 dermatoscope (DermLite; 3Gen, San Juan Capistrano, CA, USA) paired with a smartphone camera was used for dermatoscopic image acquisition. Clinical pictures were obtained with smartphone cameras. Captured images were not proceeded/manipulated in any aspect.

Statistical Analysis

For the statistical analysis we have employed a series of Chi-squared tests for independence and independent samples t-tests with Python v3.12 (SciPy v1.11.3, seaborn v0.13.2). $P<0.05$ was considered statistically significant for all tests. All methods were carried out in accordance with relevant guidelines and regulations. Ethical approval was waived by the Ethics Committee of Ethics Committee of the Ivano-Frankivsk National Medical University (No 145/24),

Ethics Committee of the Medical University of Białystok (APK.002.403.2024) and Ethics Committee of the Ss Cyril and Methodius University of Skopje (03.5505/2).The informed consent to publication form was signed by the patients whose images are included in this study and/or their legal guardian(s). The data underlying this article are available at Harvard Dataverse at https://dataverse.harvard.edu/api/access/datafile/10126337

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Results

A total of 111 patients (74 males, 37 females; mean age 49.75 years) contributed 356 photographs (mean, 3.21 photos per patient). The results are presented in Table 1. In our study group, we found no correlation between red fluorescence and age (*P*=0.603) or sex (*P*=0.247). Psoriatic subtypes exhibiting red fluorescence more frequently included inverse, follicular, guttate, and plaque psoriasis (*P*=0.006), with a notable reduction in frequency in palmoplantar variants (Figure 1A-I). Red fluorescence under UVFD was

Table 1. Demographic and Clinical Data of 356 Psoriatic Lesions Analyzed for the Presence of Red Fluorescence Under UV-Induced Fluorescence Dermatoscopy.

Psoriasis Cases (n=111)				
Demographics			**P**	
Mean age (years)	49.75		0.603*	
M/F ratio	2.0		0.247*	
Geographic region	**Red fluorescence**		**%red**	**P**
	Yes	**No**		
Central Europe	128	74	63.37	**0.022****
Southern Europe	78	76	50.65	
PASI	**Red fluorescence**		**%red**	**P**
	Yes	**No**		
<5	35	43	44.87	**0.005***
5-10	68	55	55.28	
>10	103	52	66.45	
Site	**Red fluorescence**		**%red**	**Fluorescence frequency**
	Yes	**No**		
Thigh	31	5	86.11	*High* (≥66.67%)
Buttock	11	2	84.62	
Armpit	3	1	75.00	
Groin	3	1	75.00	
Intergluteal fold	8	3	72.73	
Trunk	61	25	70.93	
Genital area	10	5	66.67	
Forearm	16	10	61.54	*Medium* (33.34-66.66%)
Lower leg	35	22	61.40	
Feet (dorsum)	2	2	50.00	
Upper arm	15	21	41.67	
Head & neck	1	3	25.00	*Low* (≤33.33%)
Feet (sole)	1	4	20.00	
Scalp	5	20	20.00	
Face	1	6	14.29	
Hand (dorsum)	2	12	14.29	
Hand (palm)	1	8	11.11	

Table 1 continues

Table 1. Demographic and Clinical Data of 356 Psoriatic Lesions Analyzed for the Presence of Red Fluorescence Under UV-Induced Fluorescence Dermatoscopy. ***(continued)***

Clinical subtypes	Red fluorescence		%red	P
	Yes	No		
Inverse	23	9	71.88	0.006**
Follicular	5	2	71.43	
Guttate	38	21	64.41	
Plaque	138	105	56.79	
PP	2	12	14.29	
PP pustular	0	1	0.00	
Season	**Red fluorescence**		**%red**	**P**
	Yes	**No**		
Spring	66	38	63.46	0.004**
Summer	23	37	38.33	
Autumn	20	19	51.28	
Winter	97	56	63.40	
Bathing on the day of the examination	**Red fluorescence**		**%red**	**P**
	Yes	**No**		
No	186	132	58.49	0.605**
Yes	20	18	52.63	

%red – percentage of lesions exhibiting red fluorescence under ultraviolet fluorescence dermatoscopy * Independent sample t-test, ** Chi-squared for independence. Abbreviations: F: female; M: male; n: number of patients; PASI: psoriasis activity score index; P: statistical; significance; PP: palmoplantar

associated with higher PASI scores (P=0.005) and correlated with erythema (P=0.008) and induration (P=0.034), but not desquamation (P=0.752) intensity in photographed psoriatic lesions. A significant geographic variability in the red fluorescence of psoriatic lesions was observed between Central and Southern Europe (P=0.022), with the winter and spring months showing a higher frequency of this phenomenon (P=0.004). Red fluorescence in psoriasis was predominantly observed on thighs, buttocks, armpits, groin, intergluteal folds, trunk, and genital areas. Bathing practices on the day of examination in psoriasis did not affect the UVFD pattern significantly (P=0.605) (Figure 1J-M).

Discussion

We have confirmed that red fluorescence under UVFD was associated with higher PASI scores [8], which is in line with a previously reported correlation between excited fluorescence under Wood's lamp and disease severity [11]. In our study, we have demonstrated that erythema and induration are the key contributing factors. We hypothesize that vasodilation, inflammation, and papillomatosis may play crucial roles in the deposition of protoporphyrin IX within the stratum corneum and may influence UVFD findings. We believe that UVFD can be used as an auxiliary tool in erythematous psoriatic plaques without scales to rule out clinical differential diagnoses. It is still unclear whether the treatment modalities reducing induration or erythema could affect the UVFD fluorescence patterns. We posit that geographic, seasonal, and anatomic variabilities of excited red fluorescence can be explained by the influence of sunlight on reducing protoporphyrin IX fluorescence in areas exposed to sunlight, particularly during sunny months and in warmer geographic regions (lighter clothing and outdoor activities). Speculatively, the lack of red fluorescence on the scalp observed in our study group may be related to the presence of *Malassezia* spp., given that the fungus exhibits enzymatic activity that suppresses porphyrin production in various clinical contexts, leading to the formation of "blackout areas" observed in pityriasis versicolor and seborrheic dermatitis [4,5]. In patients assessed with UVFD, taking a detailed history concerning bathing and application of drugs/cosmetics may hugely affect the interpretation of the observed fluorescence patterns [4]. Conversely to Corynebacterium-related red fluorescence of porphyrins in erythrasma and pitted keratolysis [4,10], patterns of excited red fluorescence in psoriatic plaques in our study were not significantly affected by bathing practices. The observed differences may be related to spatial distribution of the fluorophores. In erythrasma and pitted keratolysis, porphyrins are present on the surface of

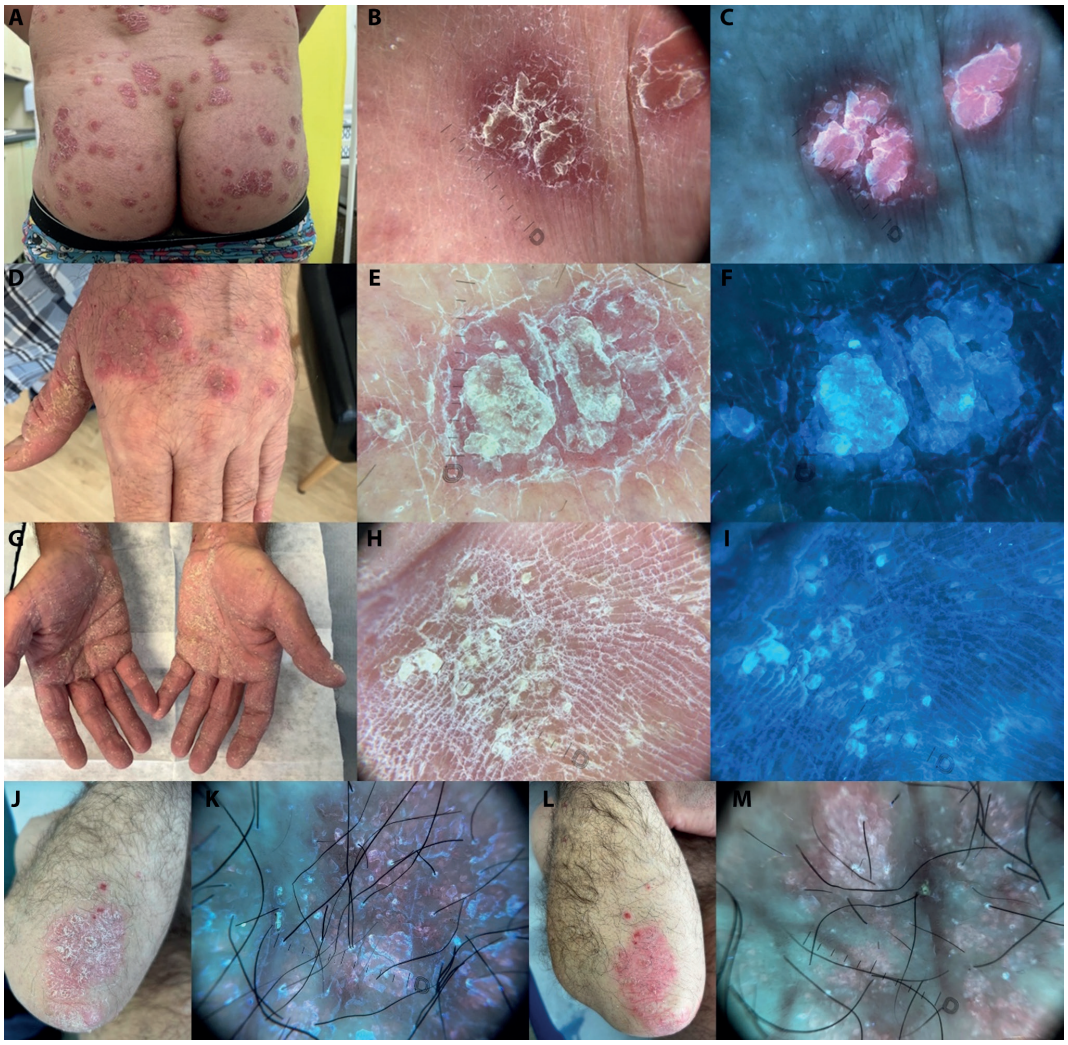

Figure 1. (A) Plaque psoriasis: trunk lesion (sun-protected area), clinical presentation. (B) Non-contact polarized dermatoscopy showing diffuse white scales. (C) Non-contact ultraviolet-induced fluorescence dermatoscopy (UVFD) displaying red protoporphyrin IX fluorescence. (D) Hand dorsum lesions (sun-exposed area), clinical presentation. (d); (E) Non-contact polarized dermatoscopy exhibiting diffuse white scales. (F) UVFD shows only bright blue fluorescence of keratin. (G) Palmoplantar psoriasis: hyperkeratotic plaques located on both palms, clinical presentation. (H) Non-contact polarized dermatoscopy exhibiting diffuse yellowish white scales. (J) UVFD displays only bright blue fluorescence. Psoriatic plaques: clinical presentation before washing. (K) UVFD presentation displaying red excited fluorescence of protoporphyrin IX and bright blue fluorescence of keratin. (L) Clinical presentation after washing with soap. (M) UVFD presentation shows retained red fluorescence.

the epidermis and thus can be easily removed with bathing, whereas in psoriasis they can be detected in the stratum corneum [12].

Conclusions

In this study we have demonstrated a correlation between sun exposure and the photo-bleaching of red fluorescence in psoriatic lesions, particularly noting that lesions in sun-protected areas more frequently display red fluorescence patterns under UVFD. The observed seasonal and geographic variability further substantiates this relationship. Our findings confirm that red fluorescence pairs with disease severity, as evidenced by higher erythema and induration scores of the assessed lesions. Moreover, we have shown that bathing practices do not influence the fluorescence patterns observed in psoriasis. We believe that our research contributes to a deeper understanding of the patterns of red fluorescence under UVFD in psoriasis.

Ethical Approval was waived by the Ethics Committee of the Ivano-Frankivsk National Medical University (No 145/24), Ethics Committee of the Medical University of Białystok (APK.002.403.2024) and Ethics Committee of the Ss Cyril and Methodius University of Skopje (03.5505/2).

The Consent to Publication form was signed by the patients included in this study.

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