Dermatology Practical & Conceptual

Ultraviolet-Induced Fluorescence and Sub-Ultraviolet Reflectance Dermatoscopy of Grover's Disease (Transient Acantholytic Dermatosis): A Retrospective Single-Center Cohort Study

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ABSTRACT

Introduction: Grover's disease (GD) is a rare acantholytic skin disorder typically characterized by pruritic vesicular or keratotic truncal papules, most commonly affecting older Caucasian males. Ultraviolet-induced fluorescence dermatoscopy (UVFD) and sub-ultraviolet reflectance dermatoscopy (sUVRD) are novel imaging techniques with potential diagnostic value in dermatology.

Objectives: The objective of this study was to evaluate the dermatoscopic patterns of GD using UVFD and sUVRD techniques.

Methods: A retrospective observational single-center cohort study was conducted including consecutive adult patients diagnosed with GD. Dermatoscopic images were obtained using a Dermlite DL5 dermatoscope paired with a smartphone for UVFD and a Casio DZ-D100 Dermocamera for sUVRD.

Results: Among the 23 investigated patients (15 females, 8 males; mean age 49.13 years), UVFD images frequently showed central polygonal bright scales with a greenish background. sUVRD images demonstrated hyporeflective polygonal scales, hyperreflective halos, and vascular patterns at the periphery. sUVRD was superior to UVFD and CD in the detection of semi-specific polygonal scales in GD. Eccrine duct involvement was observed in 76.31% of sUVRD images and 57.89% of matching conventional polarized dermatoscopy images. Contrary to the existing literature, female patients represented a higher percentage of the cohort. Twelve GD patients (52.2%) had a personal history of skin cancer.

Conclusion: UVFD and sUVRD effectively characterized the unique features of GD lesions. Our findings suggest that GD may affect younger individuals and females more frequently than previously reported, potentially indicating underdiagnosis in this population. Incorporating dermatoscopy into routine examinations may improve the detection and management of GD.

Introduction

Grover's disease (GD), also known as transient acantholytic dermatosis, was first described by the American dermatologist Ralph Weir Grover in 1970 [1]. This rare acantholytic disorder manifests as moderately pruritic vesicular or keratotic papules [2]. In its classic form, the lesions are distributed over the trunk, mainly the chest, whereas extensive variants affect additional skin sites [3]. Despite being termed "transient", GD may last from weeks to years, with a tendency to seasonal, periodic recurrence. It is more common in males (2.4:1 M/F ratio) of Caucasian origin, and the mean age at onset of GD is 61 years [4]. It has been speculated that GD involves acrosyringia [4] and is related to an increased risk of malignancy [5].

Dermatoscopy is a noninvasive diagnostic method useful in both neoplastic and general dermatology (non-neoplastic diseases) [6], including GD. Dermatoscopy allows for the visualization of structures invisible to the naked eye and improves diagnostic accuracy when compared to the naked eye examination. GD features quasi-specific clues (shared with Darier's disease) seen with conventional non-contact polarized dermatoscopy (CD), namely central, yellow-to-brown polygonal scale (erosion), surrounded by a whitish halo, further outlined with a pinkish area [7,8] (Figure 1A-F). Ultraviolet-induced fluorescence dermatoscopy (UVFD) and sub-ultraviolet reflectance dermatoscopy (sUVRD) are two novel dermatoscopy modes that are commercially available [8]. The former utilizes ultraviolet (365nm)-excited fluorescence of the fluorophores [9,10], whereas the latter is based on reflectance and absorption of purple light (405nm) in the skin [8]. To date, little is known about UVFD and sUVRD features of GD in the literature.

In the present study, we sought to explore the demographic data in GD patients, evaluate the dermatoscopic patterns of GD using UVFD and sUVRD techniques, and compare them to the polarized dermatoscopy findings (Figure 2A-D).

Materials and Methods

In this retrospective single-center cohort study, performed between January 2023 and December 2024 in Poznań, Poland, we explored the patterns of UVFD/sUVRD in consecutive cases of pathology-confirmed GD in adults. Exclusion criteria consisted of other overlapping dermatoses of similar presentation and any treatment or cosmetic application six weeks before the examination. A Dermlite DL5 dermatoscope (Dermlite, San Juan Capistrano, CA, USA) paired with a smartphone camera was used for UVFD image acquisition. A Casio DZ-D100 Dermocamera (Casio, Tokyo, Japan) was used to obtain sUVRD photographs. Both devices were used to collect clinical and CD photographs as a part of routine examinations. For UVFD we assessed the presence of polygonal scales (bright or dark) and greenish background, whereas in sUVRD we assessed the presence of hyporeflective polygonal scale, hyperreflective halo, hyperreflective eccrine microcircles, and vascular pattern at the periphery (dots, lines looped distributed radially, or none). CD evaluation included the presence of central polygonal scale, white intermediate area, peripheral pink area, eccrine microcircles, and vessels (dots, lines looped distributed radially, or none). All images used for the quantitative study remained unprocessed. All evaluations were performed by two investigators; a third investigator served as a referee and resolved discrepancies.

Statistical Analysis

Differences in the visibility of clues between CD, UVFD, and sUVRD were statistically assessed with z-test, whereas comparisons in visibility of acrosyringial involvement between

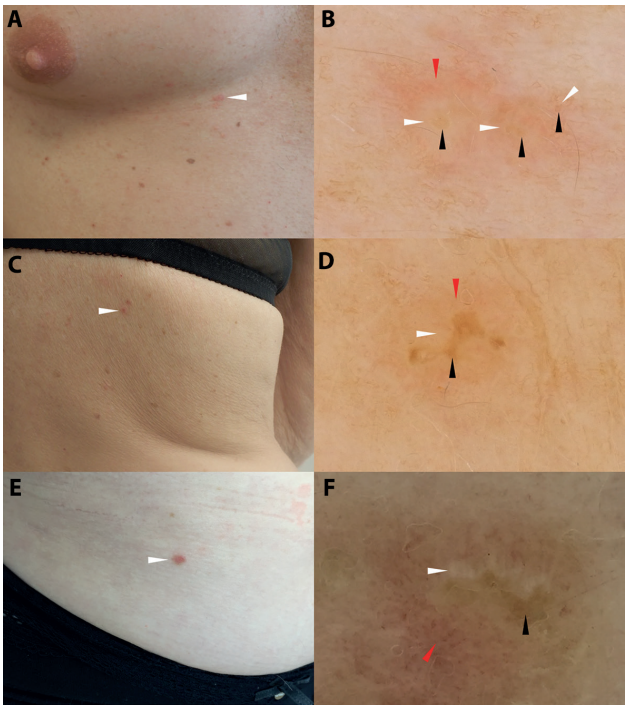

Figure 1. Presentation of Grover's disease in an atypical setting: (A) Grouped papules located on a chest of a 38-year-old male (white arrowhead); (B) Contact polarized dermatoscopy displaying yellow polygonal serous crusts (black arrowheads) surrounded by white outlines (white arrowheads), located over a common pink area (red arrowhead) (Casio DZ-D100 Dermocamera, original magnification 20×); (C) Multiple disseminated papules on a back of a 70-year old female (Casio DZ-D100 Dermocamera, original magnification 20x); (D) Polygonal brown-orange crust (black arrowhead) surrounded by white zone of acanthosis (white arrowhead), located over a pink area (red arrowhead) (Casio DZ-D100 Dermocamera, original magnification 80×); (E) Solitary lesion on abdomen of a 45-year-old female (white arrowhead); (F) Polygonal brownish crust (black arrowhead) surrounded by white outline of acanthosis over a pink area (red arrowhead) (DL5 paired with iPhone 6, original magnification 10×) (Figure © Paweł Pietkiewicz).

matching cases imaged with CD and sUVRD were assessed with McNemar's test. Relations between the number of lesions (≤3 for solitary, >3 for multiple), presence of symptoms, sex (M/F), and age (<60 years, ≥60 years) were assessed with chi-squared tests. Statistical analysis was performed using Python v3.11.4 (SciPy v1.11.4, Seaborn v0.13.2). *P*-values <0.05 were considered statistically significant for all tests.

The study was approved by the Scientific Ethics Committee for Health Sciences of Pontificia Universidad Católica de Chile (Approval #211213001). The informed consent to publication form was signed by the patients whose images were included in this study. The data underlying this article are available at Harvard Dataverse at https://doi.org/10.7910/DVN/S9KOMP. The manuscript was prepared in alignment with the STROBE guidelines.

Results

A total of 2,484 medical records from a single private dermatology clinic were evaluated to identify unique GD patients. There were 980 first-visit patients, 1,400 returning visits, and 104 prescription visits. We included 23 unique patients with GD (fifteen females, eight males; mean age 49.13 years, min. 27, max. 81 years), corresponding to 0.11% first-time visits (Table 1). Multiple lesions (>3) were present in 62.5% of male vs. 46.47% of female patients, yet the differences between sexes were not statistically significant (chi-squared test; *P*=0.775). Although all patients ≥60 years and only 42.11% of patients <60 years had multiple lesions, this trend did not prove to be statistically significant (chi-squared test; *P*=0.12). A total of 60 lesions were photographed as part of the routine examination (mean, 2.68 images per patient;

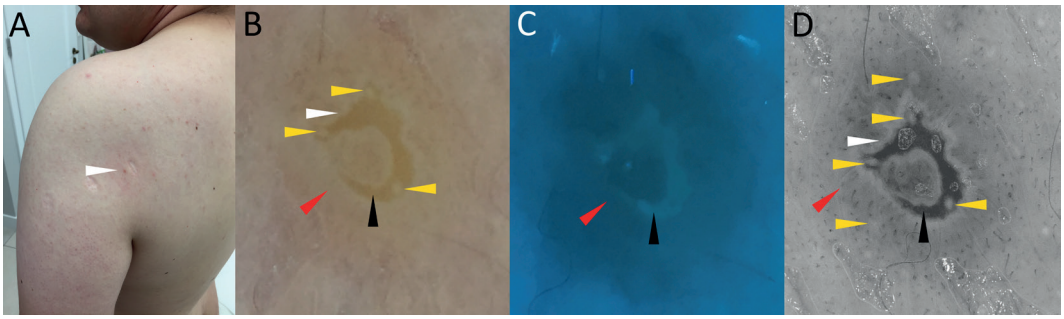

Figure 2. Dermatoscopic presentation of solitary Grover's disease lesion in a renal transplant patient: (A) Clinical presentation of an isolated papule on a left shoulder (white arrowhead); (B) Contact polarized dermatoscopy displaying yellow polygonal serous crust (black arrowhead) surrounded by white outline (red arrowhead) over a pink area (red arrowhead). Note the white clods of eccrine duct ostia (yellow arrowheads) (DL5 paired with iPhone 6, original magnification 10×); (C) Ultraviolet-induced fluorescence dermatoscopy showing central polygonal bright scale (black arrowhead) over greenish background (red arrowhead) (DL5 paired with iPhone 6, original magnification 10×); (D) Sub-ultraviolet reflectance dermatoscopy showing central hyporeflective polygonal scale (black arrowhead) outlined with hyperreflective halo (white arrowhead); Background was marked with red arrowhead (Casio DZ-D100 Dermocamera, original magnification 10×). Radially arranged linear looped vessels and dotted vessels can be seen at the lesion's periphery. Of note, hyperreflective microcircles of eccrine duct openings, both within the erosion and peripheral inflammatory area, remain intact (yellow areas). (Figure © Paweł Pietkiewicz)

Table 1. Demographic and Clinical Data of the Study Group.

Demographics (N=23)	
Parameter	**Value**
Mean Age (years)	49.13
M/F Ratio	0.53
Symptomatic (%)	21.74
Lesion distribution by site (N=60)	n (%)
Chest	40 (66.67)
Abdomen	7 (11.67)
Back	5 (8.33)
Flank	5 (8.33)
Thigh	2 (3.33)
Arm	1 (1.67)

60 non-contact polarized images, 55 UVFD, 40 sUVRD); 21.74% of patients were symptomatic (4/15 females, 1/8 males), yet no statistically significant difference was found between the sexes (chi-squared test; *P*=0.43). Dermatoscopy patterns for all the different light modes are presented in Table 2. sUVRD was superior to UVFD (95.00% vs 76.36%; z-test: *P*=0.0139) and CD (95.00% vs 78.33%; z-test: *P*=0.022) in detecting semi-specific central polygonal scales. There was no significant difference in this aspect when comparing UVFD and CD (z-test: *P*=0.801).

Eccrine duct opening involvement within the central scale or peripheral inflammatory area was detected in 80% sUVRD and 30% of conventional CD dermatoscopy images. When considering only sUVRD images (N=40), pale microcircles of eccrine duct openings were detected in 43.75% matching CD images, making sUVRD superior in this regard (McNemar's test; *P*<0.001).

A total of 12 GD patients (52.2%) had a personal history of concomitant or past skin cancer: basal cell carcinoma (BCC) (30.4%), melanoma (26.1%), and squamous cell carcinoma (SCC) (13.0%). In 13 cases (56.5%), GD was detected during total body dermatoscopy.

Table 2. Ultraviolet-Induced Fluorescence, Sub-Ultraviolet Reflectance, and Conventional Non-Contact Polarized Dermatoscopic Clues of Assessed Lesions of Grover's Disease (N=60).

UVFD (N=55)	
Feature	**N (%)**
Central polygonal bright scale	42 (76.36)
Central polygonal dark scale	1 (1.82)
Greenish background	47 (85.45)
sUVRD (N=40)	
Feature	**N (%)**
Central hyporeflective polygonal scale	38 (95.00)
Hyperreflective halo	33 (82.50)
Hyperreflective eccrine microcircles	32 (80.00)
Vascular pattern (overlap possible)	
Radially distributed linear looped vessels	20 (50.00)
Peripheral dots	14 (35.00)
None	13 (32.50)
Polarized dermoscopy, non-contact (N=60)	
Feature	**N (%)**
Central yellow-to-brown polygonal scale	47 (78.33)
White intermediate area	50 (83.33)
Peripheral pink area	53 (88.33)
Pale eccrine microcircles	18 (30.00)
Vascular pattern (overlap possible)	
Radially distributed linear looped vessels	17 (28.33)
Peripheral dots	22 (36.67)
None	28 (46.67)

Abbreviations: F: female; N: number of cases; M: male; sUVRD: sub-ultraviolet reflectance dermatoscopy; UVFD: ultraviolet-induced flu.

Discussion

GD is an epidermal acantholytic disorder resulting from the loss of cell-cell adhesion due to desmosome instability and aggravated by heat, sweating, or microbial imbalance [11]. Other contributing factors are exposure to ultraviolet radiation, immunosuppression, organ transplantation, HIV, mechanical trauma, hospitalization, prolonged bedrest, renal failure, exposure to honeybee venom, and a number of medications, including cancer therapeutics [3,12-14]. Considered by some to be a rare dermatosis, it typically affects 0.1% of the total population. As the disease can greatly impact the quality of life, a correct and prompt diagnosis is of paramount importance. GD has been reported to predominantly affect males (M/F ratio of 2.4:1), with a peak incidence at 48 to 61 years of age [4,15]. Interestingly, even though the mean age and incidence in our study matched previous reports, females were more commonly affected than males (M/F ratio of 0.53). In the authors' opinion, this discrepancy may be incidental due to a relatively small study group or may originate from the demographic differences between patients attending private and public healthcare, particularly before midday. Female predominance in this particular setting could be explained by the fact that working males are reluctant to seek private health screening [16]. Even though the literature data suggest that the majority of patients with typical presentation are symptomatic [3], only a minority of our patients were aware of the lesions or complained of

pruritus and burning sensation. We speculate that many patients may present with few recurrent oligosymptomatic or asymptomatic lesions, including with extra-truncal involvement, making the disease likely underdiagnosed, neglected, or mistaken for other conditions and thus underreported when based only on naked-eye physical examination. It is also possible that the specific sampling bias–e.g., type of practice (frequent full body checks and using a dermatoscope as a part of routine examination regardless of the cause and higher vigilance)–was responsible for the increased detection of GD. Based on the reported M/F ratio, we speculate that the neglected population may include middle-aged females, and to a lesser extent, middle-aged males. This underrepresentation may result from a mismatch between age group and the male predominance previously reported in the literature, leading clinicians to overlook the disease in these groups. Although future studies are required to investigate these hypotheses, caution concerning oligosymptomatic patients, particularly outside previously reported risk groups, is advised.

Inflammoscopy (dermatoscopy of non-neoplastic dermatoses) is becoming an indispensable part of medical examination in the field of dermatology [17]. There is also greater interest in the description of the dermatoscopic features of non-neoplastic dermatosis. Two novel imaging techniques based on ultraviolet and close-to-ultraviolet light illumination – namely, UVFD and sUVRD – have been introduced over the last five years. Until now, only a single case of GD has been characterized by UVFD. In a review paper on both methods, the authors described a central polygonal bright scale imposed over a darker background seen under UVFD. This finding was confirmed in our study. These structures correspond to serum-induced bluish/greenish excited fluorescence of the serous scale and inflammatory infiltrate, respectively, seen as a yellow-to-brown polygonal scale with a whitish outline and pink background visualized with CD (Figure 1) [8].

On the other hand, sUVRD in the assessed GD cases showed a hyporeflective polygonal scale (likely due to the trace of hemoglobin with a peak absorption at 405 nm) surrounded by a hyperreflective outline of acanthosis and mildly hyperreflective area of inflammation, frequently with a vascular pattern of looped and/or dotted vessels (Figure 1).

There are four main histopathologic patterns of GD: Darier-like (with focal acantholytic dyskeratosis, Figure 3), pemphigus vulgaris-like, or pemphigus foliaceus-like (featuring few acantholytic keratinocytes over suprabasilar clefts), Hailey–Hailey-like (displaying numerous acantholytic keratinocytes over suprabasilar clefts), and spongiotic pattern (with acantholytic keratinocytes within the spongiotic foci) [18]. Other, less common patterns include lentiginous patterns (presenting with papillomatosis with some solar lentigo-like or Dowling-Degos-like basal hyperpigmentation) [19-21], porokeratotic (oblique parakeratotic columns located over areas of agranulosis, occasional dyskeratotic cells in the upper epidermis, and basal vacuolar degeneration) [21,22], epidermolytic hyperkeratosis [21,23-25], vesicular (intraepidermal vesicles with minimal spongiosis or acantholysis on their sides) [23], lichenoid (vacuolar degeneration and scarce interface dermatitis, with occasional dyskeratotic keratinocytes and barely recognizable acantholysis) [23], and dysmaturative (dysmaturated keratinocytes with polymorphic nuclei and slight hyperchromasia) [21,26]. Some authors have previously suggested that GD may begin at or involve acrosyringia [4,14,27–29]. Eccrine duct ostia can be visualized under dermatoscopy and play a role in several skin disorders [30–34]. In our study, pale microcircles of eccrine duct openings were detected either within the central scale or peripheral inflammatory area in the minority of CD images but in the majority of sUVRD images (Figure 1 and Table 2), which could support their role in disease etiopathogenesis. Our observations require further verification in larger studies.

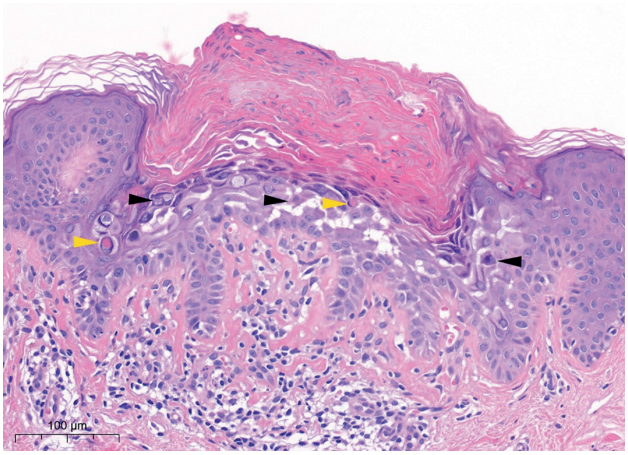

Figure 3. Pathology of Darier-like Grover's disease exhibits suprabasal acantholysis with apoptotic (yellow arrowheads) and dyskeratotic cells (black arrowheads) (H+E routine stain, original magnification 200×).

The relationship between GD and malignancy, including skin cancer, has recently been suggested by some authors [5,15]. In a study on 72 GD patients, 16.67% had a history of skin neoplasm, not otherwise specified [15]. On the other hand, GD may mimic keratinocytic cancers, particularly actinic keratosis/intraepithelial SCC, with actinic keratosis-like morphology (epithelial buds with atypia), nuclear pleomorphism, keratinocyte dysmaturation, and granular layer alteration (large and prominent cells) [26,35] or BCC (trichoblastic proliferation-like areas) [26]. A number of cases and case series describing the link with skin neoplasms have been published to date [36-38]. There are no national registry-based estimations of the skin cancer incidence

among targeted treatment-naive skin cancer GD patients. Among nine such patients reported in the literature, all nine had a history of BCC, three of SCC, and one of melanoma [5,15,37,39]. Cumulative sun damage and immunosuppression may be the main contributing factors to the link between GD and skin cancer.

It is also important to differentiate between "primary" GD developing in skin cancer patients and GD-like reaction caused by skin cancer-targeting drugs, including recombinant human IL-4, immune checkpoint inhibitors, BRAF inhibitors, Hedgehog inhibitors, EGFR inhibitors, or other chemotherapeutics [38,40-49]. Interestingly, a recent national registry-based study from Sweden reported an increased risk of keratinocyte carcinoma (BCCs and SCCs combined, and BCC only) in Darier's disease, which belongs to the same spectrum of acantholytic dermatoses [50]. Although clinically distinct from GD, both entities may feature overlapping dermatoscopic and histopathologic features and share common mechanisms of pathogenesis, including overexpression of yes-associated protein (YAP) [51], which is involved in development of keratinocytic tumors [52,53]. Moreover, gene sequencing of GD lesions identified an acquired mutation of *ATP2A2* [54], a defective gene responsible for Darier's disease [55,56]. In our dataset, 52.2% of GD patients had a history of skin cancer. On the other hand, over a half of our GD cases were detected during total body dermatoscopy, making the results hard to extrapolate to a wider population. Nonetheless, we believe that these findings necessitate further research to better understand the interplay between GD and skin cancer.

The exact mechanism by which keratinocytes detach from each other in GD is probably multifactorial, involving hyperactivated ERK pathway and claudin family of proteins [5,11]. Even though GD is not considered to be an autoimmune blistering dermatosis, desmosome disruption may result in epitope spreading. This mechanism is likely responsible for concomitance of GD and pemphigus foliaceus [57] and of GD and bullous pemphigoid [58]. Desmosomal proteins are involved not only in maintaining cell-cell adhesion but also participate in signal transduction, regulation of expression of proteins, and cell behavior [59-61].

Limitations

Our study has some limitations. For socioeconomic reasons, the results obtained in a setting of Caucasian patients from a single private Central European dermatology practice focusing mainly on skin cancer screening may not be representative of the general population. Fair skin types, higher sun damage, previous history of skin cancer, and/or history of other malignancies may be responsible for increased skin cancer risk in this group. All these factors may have biased the incidence, age at onset, and particularly the M/F ratio in our study group. Despite the high prevalence of skin cancer in our cohort, the study was not designed for this objective and may represent referral bias. No control group was included. Future studies should utilize central registries for the assessment of skin cancer risk in GD patients.

Conclusions

We present CD, UVFD, and sUVRD features in a series of consecutive GD patients. Our findings indicate that GD commonly involves acrosyringia. In some populations, the disease may affect more females and younger patients than previously reported in the literature. Along with the oligo- or asymptomatic course of the disease, these factors may contribute to a lower detection rate. We have demonstrated that sUVRD, but not UVFD, was superior to CD in detecting semi-specific polygonal scales in GD. Including dermatoscopy in general dermatology practice may contribute to optimizing the diagnosis and management of GD patients.

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