

Chronic Actinic Dermatitis Revisited

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Background: Chronic actinic dermatitis (CAD) is a persistent eczematous photodermatitis classically described in older, white men with contact allergy to plants. However, evidence from recent studies suggests that some demographics of CAD patients may be changing.

Objective: The aims of the study were to determine the frequency of CAD in patients presenting with photosensitive eruptions and to identify the allergens and photoallergens most closely associated with this condition.

Methods: We identified all patients with a diagnosis of CAD from 246 consecutive records of patients undergoing photopatch testing from July 1994 to June 2018 and summarized the demographics and test results in comparison with non-CAD patients.

Conclusions: Nineteen (7.7%) of the 246 patients evaluated had CAD with a male-to-female ratio of 1:1.7 among CAD patients. Compared with non-CAD patients, photocontact allergy and/or contact allergy to sesquiterpene lactone mix and contact allergy to fragrances were significantly more common in CAD. Contact allergy to *p*-phenylenediamine was also common. The results of this study suggest that CAD presents in a broader demographic range, including both men and women of both light and dark skin types. Phototesting and photopatch testing should be considered when patients present with clinical findings consistent with CAD.

Chronic actinic dermatitis (CAD) is an idiopathic photodermatosis that manifests as a prolonged, eczematous eruption in sun-exposed areas and histological characteristics of eczematous changes with or without lymphoma-like features.¹ The term *chronic actinic dermatitis* was initially coined as a unifying diagnosis encompassing a spectrum of chronic photosensitive dermatitides, including chronic photocontact dermatitis, photosensitive atopic dermatitis, persistent light reactivity (PLR), and actinic reticuloid (AR).^{2,3} Aside from history and clinical examination, photobiological testing is crucial to the diagnosis, as patients with CAD characteristically exhibit reduced minimal erythema doses (MEDs) to UVB and/or UVA.^{2,4}

Chronic actinic dermatitis was originally described most frequently in older, white men with high rates of contact allergy to plants and fragrances,⁵ but recent studies have suggested that this disease also affects younger female patients, particularly those with darker skin or atopic dermatitis.^{6,7} In addition, studies have also reported associations with various contact/photocontact antigens, including plant derivatives (particularly *Compositae* species), fragrances, sunscreen components, and *p*-phenylenediamine in hair dyes and black henna tattoos.^{7,8} It has been hypothesized that changes in

exposures to these allergens may be in part responsible for the changing demographics of CAD patients.

The aims of this study were to determine the frequency of CAD in a group of patients undergoing photopatch testing for evaluation of photosensitivity and to identify the demographics and allergens most closely associated with CAD.

METHODS

We performed a retrospective review of a database containing records of patients who underwent patch testing by the senior author (D.V.B.) in Kansas City, Kansas (July 1994–March 2011), and in New York, New York (April 2011–June 2018), including 246 patients with history of a photodistributed or photoexacerbated dermatitis who underwent photopatch testing and 3240 patients who underwent patch testing. Demographic characteristics and test results of patients with CAD, diagnosed based on clinical and photobiological criteria outlined in Table 1, were summarized and compared with those of patients with other diagnoses.

Phototesting was performed using a clinical phototherapy unit (National Biological, Beachwood, OH) equipped with a bank of 24 lamps each for the UVA and narrowband (nb)–UVB light sources. The irradiance of the light sources was monitored and routinely calibrated using varying accepted instruments; a Daavlin X-96 light meter (Daavlin International Corp, Bryan, OH) is in current use.

Photopatch and patch testing were conducted using Finn chambers (Epitest Ltd Oy, Tuusula, Finland) fixed with Scanpor tape (Bard Medical, Covington, GA). Test allergens were purchased from Chemotechnique Diagnostics (AB, Malmö, Sweden) or SmartPractice

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TABLE 1. Criteria for the Diagnosis of CAD

Criteria for the Diagnosis of CAD

1. Persistent dermatitis with lichenification ("AR" appearance) in photo-exposed areas of the body with duration >3 mo
2. Decreased MED to UVB and/or UVA
3. Absence of another more likely cause of photodermatitis, including exposure to a known photosensitizer, photocontact allergen, or photosensitivity due to another condition (eg, lupus, rosacea)

(Calgary, Alberta, Canada). All patients were tested to the North American Contact Dermatitis Group (NACDG) standard photopatch panels (Table 2) and other additional allergens at the clinician's discretion when relevant to the patient's presentation.

At the initial photopatch test visit (day 1), duplicate photoallergen panels (and, where applicable, contact allergen panels) were applied to clear skin on the patient's back, and phototesting to UVA (1.0, 2.5, 5.0, 10.0, and 20 J/cm²) and nb-UVB (Table 3) was performed on sun-protected areas of the buttocks. Photopatch-tested patients returned for MED interpretation on day 2, as defined in Table 3, at which time 1 set of the photoallergen panels was uncovered. The site was then irradiated with 10 J/cm² or one-half of the MED to UVA, whichever was lower, and the test panels were replaced. All test panels were removed on day 3, and reactions were interpreted (48- and 96-hour postplacement) using the NACDG scoring system. For contact allergens, a final interpretation +1, +2, or +3 was considered positive. For photoallergens, only photoallergic (negative reaction at covered site and positive reaction irradiated site) or combined photoallergic and allergic (positive reactions at both covered and irradiated site, but greater at the irradiated site) responses were considered positive photopatch tests.

Health Insurance Portability and Accountability Act-compliant deidentified data were retrieved and evaluated using a computer database (Access 2016; Microsoft Corp, Seattle, WA) approved as a "database study" by the institutional review boards of Columbia University Medical Center and University of Kansas Medical Center and were therefore easily transferred to Columbia University Medical Center. A *t* test was used to assess for statistical significance for continuous variables (eg, age), and a χ^2 test, or Fisher exact test in cases where any expected value was 5 or less, was used to assess the differences between the observed and expected frequencies of categorical variables; *P* < 0.05 was considered statistically significant.

RESULTS

Demographics

Nineteen (7.7%) of the 246 patients evaluated for photosensitivity were diagnosed with CAD, including 7 (9.1%) of the 77 male and 12 (7.1%) of the 169 female patients. Among the 19 CAD patients, the male-to-female ratio was 1:1.7, and the mean age at presentation was 53.4 years (range = 23–84 years). As shown in Table 4A, all

ethnicities were represented, and Fitzpatrick skin types of the patients ranged from II to IV. Although not statistically significant, Asians comprised a higher percentage of CAD patients compared with non-CAD patients. History of atopy was less common in CAD patients compared with non-CAD patients (31.6% vs 46.3%, *P* = 0.24), as was history of atopic eczema (5.3% vs 16.7%, *P* = 0.33). Demographic characteristics of CAD patients did not differ significantly between sex and locations (KS vs NY) (Tables 5A, 6A).

Phototesting and Photopatch Testing

Five CAD patients (26.3%) had reduced MED to both UVA and nb-UVB, 14 (73.7%) had reduced MED to nb-UVB only, and no patients had only reduced MED to UVA. Abnormal phototest results were significantly less common in non-CAD patients (Table 4B). There were no significant differences between sexes (Table 5B). Of the KS patients (*n* = 6), 4 (66.7%) had a reduced MED to UVA and UVB, and 2 (33.3%) had a reduced MED to UVB. In contrast, in the NY group (*n* = 13), only 1 (7.7%) had reduced MED to both UVA and UVB, and 12 (92.3%) had reduced MED to UVB only (Table 6B).

On photopatch testing, 5 (31.6%) of the CAD patients tested positive for at least 1 photoallergen, compared with 27 (11.7%) of the non-CAD patients (*P* = 0.08). The most frequent photoallergens in CAD patients (Table 7) were sesquiterpene lactone (SQL) mix with 3 positive reactions (15.8% of patients tested) and *Compositae* mix with 2 positive reactions (nonstandard allergen to which only these 2 patients were tested). In comparison with non-CAD patients, of whom only 2 (0.9%) had a positive reaction, photoallergy to SQL mix was significantly more common in CAD patients (*P* = 0.004). Individual patients also had positive reactions to ketoprofen, lichen acid mix, and cinnamic alcohol.

Contact Allergen Patch Testing

Thirteen (68.4%) of the 19 CAD patients tested positive to at least 1 contact allergen, with a mean number of 5.0 positive allergens per patient. One hundred forty-two (62.6%) of the 227 non-CAD patients tested positive to at least 1 contact allergen, with a mean of 5.0 reactions per patient (Table 4B). As shown in Table 8, in comparison with non-CAD photosensitivity patients and all patch-tested non-CAD patients, there was a statistically significant difference in the frequency of reactions to fragrance mix I (*P* = 0.016 and *P* = 0.005) and SQL mix (*P* = 0.049 and *P* = 0.004). There was also a statistically greater frequency of reactions to *p*-phenylenediamine (all female), tixocortol pivalate, and *Compositae* mix in CAD patients compared with all patch-tested non-CAD patients.

DISCUSSION

Chronic actinic dermatitis was diagnosed in 7.7% of patients referred for photosensitivity, at a slightly higher percentage in males (9.1%) compared with females (7.1%), in patients with suspected photosensitivity. Nonetheless, among patients with CAD, women

TABLE 2. Photoallergens Included in the Standard Photopatch Panels in This Study

Standard Photopatch Allergens (OTC/INCI Nomenclature)	Photopatch Panel Series*			
	1994–2000	2000–2009	2009–2013	2013–2018
Sunscreen components				
Octinoxate/ethylhexyl methoxycinnamate, 7.5% pet	•	•	•	•
Padimate O/ethylhexyl dimethyl PABA				
5% pet and 5% alcohol	•			
10% pet		•	•	•
Octisalate/ethylhexyl salicylate, 5% pet	•	•	•	•
Avobenzene/butyl methoxydibenzoylmethane, 5% pet	•	•	•	•
Homosalate, 5% pet	•	•	•	•
PABA				
5% pet and 5% alcohol	•			
10% pet		•	•	•
Oxybenzone/benzophenone-3				
3% pet	•			•
10% pet		•	•	
Sulisobenzene/benzophenone-4, 10% pet	•	•	•	•
Mexenone/benzophenone-10, 10% pet		•	•	•
Ensilazole/phenylbenzimidazole sulfonic acid, 10% pet		•	•	•
Octocrylene, 1% pet			•	•
Benzophenone-2, 1% pet			•	•
Dioxybenzone/benzophenone-8, 2% pet			•	•
Amiloxate/isoamyl- <i>p</i> -methoxycinnamate, 10% pet			•	•
Enzacamene/4-methylbenzylidene camphor, 2% pet			•	•
TEA salicylate (triethanolamine salicylate), 5% pet			•	•
Drometrizole trisiloxane, 10% pet			•	•
Ethylhexyl triazone, 10% pet			•	•
Bemotrizinol/ <i>bis</i> -ethylhexyloxyphenol-methoxyphenyl triazine, 10% pet			•	•
Diethylamino hydroxybenzoyl hexyl benzoate, 10% pet			•	•
Bisdisulizole disodium/disodium phenyl dibenzimidazole tetrasulfonate, 10% pet			•	•
Ecamsule/terephthalydene dicamphor sulfonic acid, 10% pet			•	•
Preservatives/antiseptics				
Triclosan, 2% pet	•	•	•	•
Hexachlorophene, 1% pet	•	•	•	•
Chlorhexidine diacetate, 0.5% aq	•	•	•	•
Dichlorophene, 1% pet	•	•		
Tribromosalicylanilide, 1% pet	•	•		
Thiobisdichlorophenol/bithionol, 1% pet	•	•		
Thiobischlorophenol/fentichlor, 1% pet	•	•		
Trichlorocarbanilide, 1% pet	•			
Fragrances				
Musk ambrette, 1% pet	•	•	•	•
Methyl anthranilate, 5% pet	•	•	•	•
Sandalwood oil, 2% pet	•	•		
6-Methylcoumarin, 1% alcohol	•			
Plant compounds				
Sesquiterpene lactone mix, 0.2% pet	•	•	•	•
Lichen acid mix, 0.3% pet		•	•	•
Medications				
Ketoprofen, 5% pet		•	•	•
Chlorpromazine hydrochloride, 0.1% pet	•			
Promethazine, 1% pet	•			
Miscellaneous				
Thiourea, 0.1% pet	•	•	•	•

*The standard photopatch panels were in use during the following periods: July 1994–June 2001, July 2001–March 2009, April 2009–July 2013, and August 2013–June 2018.

aq Indicates aqueous; OTC/INCI, OTC drug name/International Nomenclature of Cosmetic Ingredients; PABA, *p*-aminobenzoic acid; pet, petrolatum TEA, triethanolamine.

TABLE 3. Minimal Erythema Dosing and Interpretation of MED to UVA and UVB Low MED to UVA Defined as MED <20 J/cm² for All Skin Types

Skin Type	Nb-UVB Dosages, mJ/cm ²	Abnormal, mJ/cm ²
I	50, 100, 150, 200, 250, 300	<100
II	50, 100, 150, 200, 250, 300	<150
III	150, 200, 250, 300, 350, 400	<200
IV	200, 250, 300, 350, 400, 450	<250
V	250, 300, 350, 400, 450, 500	<300
VI	300, 350, 400, 450, 500, 550	<350

TABLE 4. Comparison of Demographics and Clinical Test Results of CAD Patients and Non-CAD Photosensitivity Patients

	Group		P
	CAD (n = 19)	Non-CAD (n = 227)	
A. Demographics			
Age at presentation, mean (SD), y	53.7 (15.7)	52.8 (17.1)	0.2217
Sex, n (%)			
Female	12 (63.2)	157 (69.3)	0.6110
Male	7 (36.8)	70* (30.8)	
Race, self-reported, n (%)			
Black	2 (10.5)	21 (9.3)	0.1454
White	12 (63.2)	182 (80.2)	
Asian	4 (21.1)	14 (6.1)	
Hispanic	1 (5.3)	9 (3.9)	
Unknown	0	1 (0.4)	
Skin type, n (%)			
I	0	10 (4.3)	0.0856
II	11 (57.9)	128 (56.4)	
III	3 (15.8)	23 (10.2)	
IV	5 (26.3)	18 (7.9)	
V	0	8 (3.5)	
VI	0	3 (1.3)	
Unknown	0	37 (16.3)	
Atopy, n (%)			
History of atopy	6 (31.6)	106 (46.7)	0.2372
History of atopic eczema	1 (5.3)	39 (17.2)	0.3271
B. Clinical test results			
Phototest results, n (%)			
Low MED to UVA and UVB	5 (26.3)	1† (0.4)	<10 ⁻¹³
Low MED to UVA only	0	16 (7.0)	
Low MED to UVB only	14 (73.7)	47 (20.7)	
Normal MED	0	163 (71.8)	
Patch testing results, n (%)			
≥1 positive photopatch reaction	5 (26.3)	27 (11.9)	0.0823
≥1 positive patch reaction	13 (68.4)	142 (62.6)	0.8054

*Including 1 transgender patient who is biologically male.

†One non-CAD patient also had reduced MEDs to both UVA and UVB. This patient was diagnosed with PLR due to the absence of CAD-like skin changes, possibly the result of the patient's strict avoidance of exposure to sunlight.

TABLE 5. Chronic Actinic Dermatitis Patients' Demographics and Phototest Results, by Sex

	Patient Group		
	Male (n = 7)	Female (n = 12)	P
A. Demographics			
Age at presentation, mean (SD), y	53.1 (13.6)	54.1 (17.3)	0.8940
Race, n (%)			
Black	0	2 (16.7)	0.4472
White	4 (57.1)	8 (66.7)	
Asian	2 (28.6)	2 (16.7)	
Hispanic	1 (14.3)	0	
Skin type, n (%)			
I	0	0	0.0805
II	3 (42.9)	8 (66.7)	
III	3 (42.9)	0	
IV	1 (14.3)	4 (33.3)	
V	0	0	
VI	0	0	
Atopy, n (%)			
History of atopy*	3 (42.9)	3 (25.0)	0.6169
History of atopic eczema	1 (14.3)	0	0.3684
B. Clinical test results			
Phototest results, n (%)			
Low MED to UVA and UVB	2 (28.5)	3 (25.0)	1
Low MED to UVA only	0	0	
Low MED to UVB only	5 (71.4)	9 (75.0)	

*History of at least 1 of the following: hay fever, eczema, and asthma.

predominated (12 women [63%] vs 7 men [37%]). This is in contrast to 2 prior large studies of photosensitivity patients in which 7.4% and 17% of patients received a diagnosis of CAD, predominantly male.^{9,10} To the best of our knowledge, this is the first report of a group of confirmed CAD patients that comprised more females than males. Although the literature on CAD has consistently reported a strong male predominance (Table 9), recent studies have suggested that the percentage of males may be decreasing,^{7,8} and one of the most recent studies of 70 CAD patients in the United Kingdom demonstrated a nearly equal number of male (53%) and female (47%) patients.⁶ Along with this decrease, recent studies also noted a concomitant rise in the percentage of younger female patients of darker skin types (IV–VI).^{6,7} The female patients in our group, however, were neither significantly different in age nor of a darker skin tone compared with male patients (although none of the CAD patients in this study were of skin type V or VI). In addition, we did not observe an increased frequency of atopic eczema in CAD patients; only 1 CAD patient (5%) in this study had a history of atopic eczema, in comparison with 39 patients (17%) in the group of non-CAD patients. The frequency of atopic eczema among non-CAD patients is comparable with the prevalence of atopic eczema in developed countries, which has been estimated at 10% to 20%.¹⁷

Although our group of CAD patients differed from the classic demographic in sex, their photobiological profiles generally match

TABLE 6. Chronic Actinic Dermatitis Patients' Demographics and Phototest Results, by Location

Location	Kansas City, KS (n = 6)	New York, NY (n = 13)	P
A. Demographics			
Age at presentation, mean (SD), y	56.8 (20.8)	51.9 (14.4)	0.6002
Female, n (%)	5 (83.3)	7 (53.8)	0.3331
Male, n (%)	1 (16.7)	6 (46.2)	
Race, self-reported, n (%)			
Black	0	2 (15.4)	0.1502
White	5 (83.3)	7 (53.8)	
Asian	0	4 (30.8)	
Hispanic	1 (16.7)	0	
Skin type, n (%)			
I	0	0	0.4223
II	5 (83.3)	6 (46.2)	
III	0	3 (23.1)	
IV	1 (16.7)	4 (30.8)	
V	0	0	
VI	0	0	
Atopy, n (%)			
History of atopy,*	1 (16.7)	5 (38.5)	0.6047
History of atopic eczema	0	1 (7.7)	1
B. Clinical test results			
Phototest results, n (%)			
Low MED to UVA and UVB	4 (66.7)	1 (7.7)	0.0173
Low MED to UVA only	0	0	
Low MED to UVB only	2 (33.3)	12 (92.3)	

*History of at least 1 of the following: hay fever, eczema, and asthma.

what has previously been described for this condition. Twenty-six percent of the CAD patients in our group had reduced MED to UVA and UVB, whereas the remainder had reduced MED to only UVB. Interestingly, we noted a difference in the phototest results between KS patients, who more frequently had reduced MED to both UVA and UVB, and NY patients, who were more likely to be sensitive to UVB only (Table 6). The significance of these differences is not clear, because prior studies have reported variations in the specific percentages of patients with sensitivity to both UVA and UVB, UVB only, and UVA only.^{4,7,13,14} Choi et al,¹³ however, noted that when a clinical grading system was used to stratify CAD severity, reduced MEDs to both UVA and UVB were observed more frequently in patients with severe disease, whereas patients with mild to moderate disease typically had reduced MED to UVB only.

Overall, there was increased frequency of positive photopatch reactions among CAD patients (26%) compared with non-CAD patients (12%). Photoallergens causing positive reactions in CAD patients included plant derivatives, a fragrance (cinnamic alcohol), and a nonsteroidal anti-inflammatory drug (ketoprofen), and photocontact allergy to SQL was significantly more frequent in

CAD patients compared with non-CAD patients. No CAD patients in this study had photoallergies to sunscreen components, in contrast to previous investigations.^{6,7}

In terms of contact allergens, reactions to fragrance mix I and SQL mix occurred with significantly greater frequency in CAD patients compared with the non-CAD photosensitivity group and all non-CAD patch-tested patients. *p*-Phenylenediamine allergy was also found more frequently in CAD patients, although the difference falls short of statistical significance compared with the non-CAD photosensitivity group (likely because of statistical power). All of the CAD patients with *p*-phenylenediamine allergy were female, whereas prior studies reported positive reactions in male patients, including one in which 5 of 6 positive reactions were in men,⁸ and another reported 3 reactions in older men of darker skin type.⁷ These authors hypothesized that the increase in *p*-phenylenediamine allergy may be the result of changes in hair-dyeing practices in men.⁸ Hair dye is the likely source of exposure for at least one of our patients, who also had strong positive reactions to black henna among her personal hair products, which probably contained *p*-phenylenediamine.

Surprisingly, CAD patients were statistically more likely to react to tixocortol pivalate than all patch-tested patients. There was also a nonstatistically significant difference when compared with non-CAD photosensitivity patients. The reason is unclear. One potential explanation is more frequent use of group A glucocorticosteroids (hydrocortisone, prednisone, etc) in CAD patients.

The types of photoallergens/contact allergens and frequency of positive reactions vary in prior studies; part of this variation is likely attributable to differences in exposure between different patient populations, as prior authors have hypothesized.^{8,18} For example, *Compositae* oleoresins were frequently noted as a contact allergen in early studies of CAD in Europe, with 47 positive reactions in 55 patients (85%)⁵ reported in one study and 29 reactions in 80 patients (36%)¹¹ in another, but was found to be much less common in a group of NY patients.¹⁸ Another study conducted at the

TABLE 7. Photoallergens With Positive Reactions in CAD/AR Patients

Photoallergen	No. (%) Patients With Positive Reactions		P
	CAD/AR (n = 19)	Non-CAD (n = 227)	
Sesquiterpene lactone mix*	3/19 (15.8)	2/227 (0.9)	0.0036
Ketoprofen	1/19 (5.3)	2/160 (1.3)	0.2873
Lichen acid mix	1/19 (5.3)	1/160 (0.6)	0.2016
<i>Compositae</i> mix†	2	—	—
Cinnamic alcohol†	1	—	—

*Four patients had positive reactions to SQL mix on photopatch or patch testing: 2 had only photoallergic reactions; 1 had both a contact allergic and photoallergic reaction; and 1 had only a contact allergic reaction.

†Photoallergens not on standard photopatch panel. No other patients were tested against these photoallergens.

Entries in bold are statistically significant.

TABLE 8. Contact Allergens Associated With Positive Reactions in >1 CAD Patient

Allergen	No. (%) Patients With Positive Reactions			P (CAD vs Non-CAD)	P (CAD vs All Patch Tested)
	CAD (n = 19)	Non-CAD Photosensitivity (n = 227)	Non-CAD All Patch Tested (n = 3224)		
Fragrance mix I	6/16 (37.5)	26/205 (12.7)	322/2978 (10.8)	0.0160	0.0051
p-Phenylenediamine	3/16 (18.8)	10/205 (4.9)	152/2962 (5.1)	0.0571	0.0470
Bacitracin	3/16 (18.8)	21/205 (10.2)	278/2979 (9.3)	0.3924	0.1844
Formaldehyde	3/16 (18.8)	19/205 (9.3)	188/2994 (6.3)	0.2035	0.0764
Balsam of Peru	2/16 (12.5)	27/205 (13.2)	238/2973 (8.0)	1	0.3721
Carba mix	2/16 (12.5)	6/205 (2.9)	139/2984 (4.7)	0.1066	0.1715
Quaternium-15	2/16 (12.5)	15/205 (7.3)	202/2976 (6.8)	0.3538	0.2987
Tixocortol pivalate	2/16 (12.5)	6/205 (2.9)	52/2973 (1.7)	0.1066	0.0327
Sesquiterpene lactone mix*	2/19 (10.5)	3/227 (1.3)	17/2956 (0.6)	0.0492	0.0044
Compositae mix†	2/18 (11.1)	6/138 (4.3)	33/2275 (1.5)	0.2316	0.0297

Only 16 of the 19 CAD patients were tested against standard contact allergen panels. For each specific contact allergen, patients who were not tested were excluded from calculations. Reactions to other plant, fragrance, preservative/antiseptic, medication, or plastic allergens occurring only in individual patients are excluded from this table. Both patients with positive contact allergic reactions to SQL mix also had positive reactions to Compositae mix.

*Includes patients tested against this allergen on the standard photopatch tray.

†Not in standard NACDG panel before 2003. Included on nonstandard photopatch trays.

same institution for 2 different time intervals found that the number of positive contact reactions to SQL mix in CAD patients decreased over time, whereas the number of reactions to p-phenylenediamine and preservatives increased.^{8,19} In this study, we account for these shifts in exposure patterns by comparing the frequency of positive reactions in CAD patients with that of a reference group (non-CAD patients with suspected photoallergy) from the same general population and period. The frequency of positive photopatch or patch reactions to SQL mix and fragrance mix I was significantly elevated in the group of CAD patients relative to the non-CAD patients with photosensitive eruptions because of other causes, suggesting that both of these allergens may contribute to the pathogenesis of CAD in

some way that other allergens do not. One prior study suggested that it may be the interaction between *Compositae* allergens and DNA in the presence of UVA radiation that results in an antigenic complex and triggers an immune response.¹⁹

Finally, it is important to note that the diagnosis of CAD is not always unambiguous. Existing literature suggests that CAD represents a spectrum of disorders that encompasses PLR and AR, with AR at the most severe end of this disease.² There have been reports of patients with photocontact or contact dermatitis that later progresses to AR, with concomitant decreases in MEDs to UVA/UVB on phototesting and typical histological changes.³ The frequency of positive reactions to photoallergens and contact allergens has

TABLE 9. Sex Demographics of CAD Patients in Selected Studies

Study Authors	Study Period	Location(s)	No. Patients	No. (%) Male
Frain-Bell and Johnson ⁵	1977–1978	Dundee, UK	55	53 (96)
Lim et al ³	1985–1988	New York, US	12	10 (83)
Lim et al ⁴	1983–1993	New York, US	51	31 (61)
		Baltimore, US		
		Tokyo, Japan		
Menagé et al ¹¹	1987–1992	London, UK	89	69 (78)
Stratigos et al. ¹²	1990–2000	Athens, Greece	15	13 (87)
Choi et al ¹³	1991–2008	Pusan, South Korea	51	42 (82)
Yap et al ¹⁴	1993–2001	Melbourne, Australia	44	37 (84)
Que et al ^{7*}	1993–2009	New York, US	40	27 (68)
Chew et al ^{8†}	2000–2005	London, UK	50	36 (72)
Tan et al ⁶	2000–2015	Manchester, UK	70	37 (53)
Hsiao and Chu ¹⁵	2002–2012	Taipei, Taiwan	15	15 (100)
Tan et al ¹⁶	2005–2009	Singapore	58	47 (81)

*Que et al⁷ reported a decline in the percentage of males from 71% to 68% between 1994 and 2009.

†Chew et al⁸ reported a decrease in the percentage of males from 78% in a 1987–1992 cohort to 72% in a 2000–2005 cohort.

led to the hypotheses that alterations in skin immune activity within a background of allergic contact dermatitis may set the stage for the future development of CAD/AR.⁸

As an illustrative case, one of the patients tested in this study was a 17-year-old adolescent boy with a history of infantile eczema who presented with a generalized, photoaggravated rash. Photobiological testing revealed a reduced MED to UVA, and patch testing showed positive reactions to cobalt, laurel oil (*Laurus* species), SQL mix, and other *Compositae* allergens. Chronic actinic dermatitis was considered, but given his age, contact allergen profile, and generalized distribution of the rash, he was diagnosed with photoexacerbated atopic dermatitis with plant aero-contact allergy. The patient was lost to follow-up, and it is unknown whether he developed (or had) CAD, because photoaggravated eczema is hypothesized to be on the spectrum of CAD, particularly CAD with reduced MED to UVA, and there have been earlier reports of photodermatitis/AR as distinct from photoaggravated eczema.^{6,20}

In addition to this patient given a final diagnosis of photosensitive atopic dermatitis, the final diagnoses among non-CAD patients included a range of disease spectra. Among these were polymorphous light eruption, drug-induced photosensitivity, photocontact or contact allergic dermatitis, rosacea, and subacute cutaneous lupus erythematosus. These patients will be the subject of a future paper. This report is intended to focus attention on some of the demographic changes that may be occurring in patients with CAD.

Limitations

The final diagnoses could not be ascertained in a few cases where the care of the patient is transferred back to the referring physician after the consultation for photobiological and patch/photopatch testing is completed. This study considered only CAD patients with features of AR and excluded patients with photosensitive eczema, photoallergic contact dermatitis, and PLR without CAD/AR features. As such, the patients in this study may represent only a subgroup of patients compared with other studies on CAD.

CONCLUSIONS

We report on a group of CAD patients who fit both the clinical and photobiological profile for the condition but whose demographics differ somewhat from the groups of patients in whom this condition has previously been described. The group of CAD patients in this study encompassed an ethnically broad demographic group and included both men and women. Thus, clinicians should be aware of the diagnostic possibility of CAD and consider phototesting and photopatch/patch testing as part of the workup in patients whose clinical picture fits the criteria for CAD even if they do not fit the classical demographic for this disease.

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