

Chronic Actinic Dermatitis: An Analysis at a Single Institution over 25 Years

Sybil K. Que, Jeremy A. Brauer, Nicholas A. Soter, and David E. Cohen

Background: Chronic actinic dermatitis (CAD) is a rare photosensitivity disorder with scant epidemiologic data.

Objective: To evaluate demographic data and results of photopatch and patch tests over a 25-year period.

Methods: Retrospective chart review of patients with CAD from 1993 to 2009.

Results: Forty patients had a mean age of 57.8 years, and 27 (67.5%) were men. Twelve patients (30%) were skin types I and II, and 17 (42.5%) were skin types V and VI. Nine patients (22.5%) were younger than 50 years, and 4 of these (44.4%) were men. One of the nine patients (11.1%) was skin type I, and 4 (44.4%) were skin types V and VI. Carba mix and para-phenylenediamine were the two most commonly positive agents in patch tests. Sunscreens and plants and plant derivatives were the most commonly positive agents in photopatch tests.

Conclusions: Our findings suggest a trend of two new classes of North American patients at our institution being diagnosed with CAD—younger women with skin types IV to VI and older men with skin types I to III. We observed a greater-than-expected number of positive patch-test reactions to para-phenylenediamine. We suggest that patch testing and photopatch testing of individuals may be useful adjuncts in the assessment of CAD.

CHRONIC ACTINIC DERMATITIS (CAD) is a photosensitivity disorder defined by a persistent eczematous reaction of 3 months' or greater duration on sun-exposed body parts, abnormally low phototest results, and a dermal infiltrate composed of lymphocytes and macrophages (sometimes with epidermal spongiosis and atypical mononuclear cells on histopathologic examination).¹

This disorder is generally thought to more commonly affect men older than 50 years and is often more severe during the summer months or after prolonged exposure to sunlight. However, CAD also has been reported in younger patients of both genders, often with a previous or concurrent diagnosis of atopic dermatitis.^{2–4}

In a previously conducted multicenter study from 1985 to 1993 that included the New York University (NYU) Charles Harris Skin and Cancer Unit, the majority of CAD patients were men older than 50 years and predominantly with skin types V and VI.¹ Using a retrospective chart review of patients assessed at the same institution from

1993 to 2009, we sought changes in the demographic representation and patterns of patch-test and photopatch-test results in patients with CAD, achieving an analysis spanning 25 years.

Materials and Methods

Patient Selection

Upon approval from our Institutional Review Board, we conducted a retrospective chart review of patients who had a diagnosis of CAD at the NYU Charles C. Harris Skin and Cancer Unit from 1993 to 2009. Patient selection was based on criteria established in earlier work from the same center, and CAD was specifically defined by the following: (1) persistent eczematous eruption on sun-exposed body areas for longer than 3 months; (2) abnormally low phototest results; and (3) dermal infiltrate composed of lymphocytes and macrophages, sometimes with epidermal spongiosis and atypical mononuclear cells on histopathologic examination.¹ Patients with CAD were identified by searching the medical records of all individuals who underwent phototesting at our institution during that time. We reviewed the electronic medical records of all patients who were assessed with either phototests or photopatch tests. Data on age, gender, skin type, mean duration of symptoms,

From the Photomedicine Section and the Occupational and Environmental Dermatology Section, Charles C. Harris Skin and Cancer Pavilion, Ronald O. Perleman Department of Dermatology, New York University School of Medicine, New York, NY.

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phototest results, patch-test and photopatch-test results, past medical and social histories, allergies, and medications were recorded.

Light Sources

Light sources used at the NYU Charles C. Harris Skin and Cancer Unit have been described previously.^{1,5} The ultraviolet A (UVA) source was provided by a bank of 47 HO-UVA bulbs (National Biologic Corp, Beachwood, OH). A circular bank of 16 FS40 bulbs (National Biologic Corp) was used as the broadband ultraviolet B (UVB) source, and a circular bank of 48 TL 100W/01-FS72 bulbs (National Biologic Corp) was used as the narrowband UVB light source. These were monitored monthly with an IL 1700 research radiometer (International Light Inc., Newburyport, MA). A quartz-halogen 82V slide-projector lamp and a 3 cm water filter contained in a polystyrene tissue culture flask positioned 15 cm away from the inner forearm served as a visible light source (Kodak, Rochester, NY).

Phototests, Photopatch Tests, and Patch Tests

Our methods for conducting phototests and photopatch tests have been described previously.^{1,5} On day 1, duplicate photoallergen series (Table 1) were applied on the right and left sides of each patient's back, and phototests with UVA, UVB, and visible light were performed; evaluations were done 15 to 30 minutes after irradiation. On day 2, the minimal erythema dose (MED)—defined as the lowest dose of ultraviolet (UV) producing a clinically identifiable erythema of the entirely irradiated 1.5 cm² area—was quantified for UVA and UVB, and sites exposed to visible light were evaluated. Further, the left-side allergen series was removed and the site was irradiated with 10 joules of UVA or 50% of the MED to UVA (MED-A), whichever was less. Twenty-four hours later (48 hours after allergen placement), the right-side nonirradiated allergen series was removed, and the reactions were interpreted with the North American Contact Dermatitis Group (NACDG) scoring system. At 96 hours after placement, a final patch-test reading was performed.^{6,7}

Regarding patch tests, we used a previously described standardized technique using Finn Chambers (Epitest Ltd Oy, Tuusula, Finland) on Scanpor tape (Norgesplaster Alpha A/S, Vennesla, Norway).⁷ On day 1, the panel of allergens (Table 2) was applied, and the patient was instructed to refrain from manipulation and bathing until the final reading on day 5. The patches having been left in

Table 1. New York University Charles C. Harris Skin and Cancer Unit Photoallergen Series

<i>Allergen</i>	<i>Concentration and Diluent</i>
<i>Sunscreens</i>	
Octyl dimethyl PABA	5% alcohol
Oxybenzone (BZP-3)	3% pet
para-Aminobenzoic acid	5% alcohol
Menthyl anthranilate	5% pet
3-(4-Methylbenzylidene) camphor (Eusolex 6300)	2% pet
Sulisobenzene (BZP-4)	10% pet
Octyl methoxycinnamate	7.5% pet
<i>Pesticides</i>	
Ziram	1% pet
Captan	0.1% pet
<i>Other chemicals</i>	
Thiourea (thiocarbamide)	0.1% pet
<i>Fragrances</i>	
6-Methylcoumarin	1% pet
Sandalwood oil	2% pet
Fragrance mix I	8.0% pet
Fragrance mix II	14.0% pet
Petrolatum control	—
<i>Antimicrobial agents</i>	
Bithionol (thiobis-dichlorophenol)	1% pet
Fenticlor (thiobis-chlorophenol)	1% pet
Sulfanilamide	1% pet
Trichlorocarbanilide	1% pet
Dichlorophen	1% pet
Triclosan	2% pet
Hexachlorophene	1% pet
Chlorhexidine diacetate	0.5% aq
Tribromosalicylanilide	1% pet
<i>Medications</i>	
Diphenhydramine hydrochloride	1% pet
Promethazine	1% pet
Chlorpromazine hydrochloride	0.1% pet
<i>Plants and plant derivatives</i>	
Chamomilla romana	1% pet
Diallyl disulfide	1% pet
Arnica montana	0.5% pet
Taraxacum officinale	2.5% pet
Achillea millefolium	1% pet
Propolis	10% pet
Chrysanthemum cinerariaefolium	1% pet
Sesquiterpene lactone mix	0.1% pet
α-Methylene-γ-butyrolactone	0.01% pet
Tanacetum vulgare	1% pet
Alantolactone	0.1% pet
Lichen acid mix	0.3% pet

aq = aqueous; PABA = para-aminobenzoic acid; pet = petrolatum.

Table 2. New York University Charles C. Harris Skin and Cancer Unit Standard Patch Test Series

<i>Allergen</i>	<i>Concentration and Diluent</i>
Benzocaine	5% pet
Mercaptobenzothiazole	1% pet
Colophony	20% pet
para-Phenylenediamine	1% pet
Imidazolidinylurea	2% aq
Jasmine absolute	2% pet
Lanolin alcohol	30% pet
Carba mix	3% pet
Neomycin sulfate	20% pet
Thiuram mix	1% pet
Formaldehyde	1% aq
Ethylenediamine dihydrochloride	1% pet
Epoxy resin	1% pet
Quaternium-15	2% pet
p-tert-Butylphenol formaldehyde resin	1% pet
Mercapto mix	1% pet
Black rubber mix	0.6% PPD 0.1% pet
Potassium dichromate	0.25% pet
<i>Myroxilon pereirae</i> (Balsam of Peru)	25% pet
Nickel sulfate hexahydrate	2.5% pet
Diazolidinylurea	1% pet
DMDM hydantoin	1% pet
Imidazolidinylurea	2% pet
Bacitracin	20% pet
Mixed dialkyl thioureas	1% pet
Methylchloroisothiazolinone/ methylisothiazolinone	100 ppm aq
Paraben mix	12% pet
Methyldibromoglutaronitrile	0.1% pet
Benzalkonium chloride	0.1% aq
Dimethylol dihydroxyethyleneurea	4.5% aq
Cocamide DEA	0.5% pet
Compositae mix	5.0% pet
Glutaral	5.0% pet
Dimethylaminopropylamine	1% aq
Ylang ylang oil	2% pet
Amerchol L-101	1% pet
Benzoyl peroxide	1% pet
Benzyl alcohol	1% pet
Benzyl salicylate	2% pet
Chlorhexidine digluconate	0.5% pet
Octyl dimethyl PABA	10% pet
Ethyl cyanoacrylate	10% pet
Hydroquinone	1.0% pet
Lavender absolute	2% pet
Lichen acid mix	0.3% pet
Triclosan	2% pet

Table 2. Continued

<i>Allergen</i>	<i>Concentration and Diluent</i>
Fragrance mix II	14.0% pet
Propolis cera	10.0% pet
Fragrance mix I	8% pet
Amidoamine	0.1% aq
2-Bromo-2-nitropropane-1,3-diol	0.5% pet
Sesquiterpene lactone mix	0.1% pet
Thimerosal	0.1% pet
Propylene glycol	30% aq
Benzophenone-3	3% pet
Chloroxylenol (PCMX)	1% pet
DMDM hydantoin	1% aq
Diazolidinylurea	1% aq
Ethyleneurea/melamine formaldehyde	5% pet
Methyldibromoglutaronitrile/phenoxyethanol	2.0% pet
Iodopropynyl butyl carbamate	0.1% pet
di-alpha Tocopherol	100% pet
Sodium gold thiosulfate	2.0% pet
Ethyl acrylate	0.1% pet
Glyceryl thioglycolate	1% pet
Tosylamide formaldehyde resin	10% pet
Methyl methacrylate	2% pet
Cobalt chloride	1% pet
Tixocortol-21-pivalate	1% pet
Budesonide	0.1% pet
Hydrocortisone-17-butyrate	1% pet
Disperse Blue 106	1% pet
Tetracaine	5.0% pet
Lidocaine	5.0% pet
Dibucaine	5.0% pet
Prilocaine	5.0% pet
Cocamidopropyl betaine	1% aq
Phenoxyethanol	1% pet

aq = aqueous; DEA = diethanolamine; DMDM = dimethylol dimethyl; PABA = para-aminobenzoic acid; PCMX = p-chloro-m-xylene; pet = petrolatum; PPD = para-phenylenediamine; ppm = parts per million.

place for 48 hours, the patients returned on day 3 to have the chambers and tape removed and for the initial reading. The patients returned 48 hours later (on day 5) for final readings. Allergic reactions were graded as described above for photopatch tests.

Results

From 1993 to 2009, 40 patients were diagnosed with CAD at the NYU Charles C. Harris Skin and Cancer Unit (Table 3). The mean age at diagnosis was 57.8 years (compared with the previously reported mean age of 63.4 years).¹ Twenty-seven (67.5%) patients were male, and the ratio of males to

Table 3. Comparison of Demographic Data and Patch and Photopatch Testing in 1994 and 2010

<i>Demographic Data</i>	<i>Study Period</i>	
	<i>1993–2009 (16 yr)</i>	<i>1985–1993 (9 yr)*</i>
Patients tested	40	35
Mean age (yr)	57.8	63.4
Male-to-female ratio	2.1:1	2.5:1
Patients with skin types I–II	12 (30%)	6 (17.1%)
Patients with skin types III–IV	11 (27.5%)	7 (20%)
Patients with skin types V–VI	17 (42.5%)	22 (62.9%)
Patients patch-tested (%)	18 (45.0%)	44 (86.3%)
Patients with positive patch-test responses (%)	12 (66.7%)	12 (27.3%)
Patients photopatch-tested (%)	30 (75.0%)	48 (94.1%)
Patients with positive photopatch-test responses (%)	17 (56.7%)	16 (33%)

*Data refer to patients tested at the New York University Charles C. Harris Skin and Cancer Unit and not to patients tested, seen, or treated at Johns Hopkins medical institutions or the Department of Dermatology, Jikei University.

females was 2.1:1; the previous study included 25 men (71.4%) and had a male-female ratio of 2.5:1. Eleven (40.7%) of the 27 men had skin types I to III, whereas 9 (33.3%) had skin types V and VI. Regarding all of the CAD patients, 17 of 40 patients (42.5%) had skin types V and VI, as compared with 22 of 35 (62.9%) previously.¹ Nine (22.5%) of the newly reported patients were younger than 50 years; 5 (55.6%) of these patients were women, and 4 (44.4%) had skin types V and VI.

Phototests were performed on all 40 patients (Table 4). Thirty-two (80%) of the patients had a low MED-A and a low MED to UVB (MED-B), 7 patients (17.5%) had a low MED-A only, and 1 patient (2.5%) had a low MED-B only. No patient developed an eczematous reaction at the UV test sites. Patch tests were performed on 18 of the 40 patients; 12 of these patients (66.7%) had positive patch-test results. The total number of allergens eliciting positive reactions was 39; the mean number of allergic reactions per patient was 3.3. The most common agents eliciting positive reactions were carba mix in 5 (27.8%) and para-phenylenediamine in 3 (16.7%) of the 18 patients tested. Other agents eliciting positive reactions were neomycin sulfate, thiuram mix, quaternium-15, bacitracin, propylene glycol, and benzalkonium chloride (Table 5).

Photopatch tests were performed in 30 patients; 17 patients (56.7%) had positive photopatch-test results. The total number of allergens eliciting positive reactions on

Table 4. Abnormal Phototest Results and Potentially Photosensitizing Medications

<i>Patient No.</i>	<i>Skin Type</i>	<i>Abnormal Responses</i>	<i>Potentially Photosensitizing Medications</i>
1	VI	MED-A: 12	—
2	III	MED-A: 3; MED-B: 12	HCTZ
3	V	MED-A: 6; MED-B: 24	Ibuprofen
4	I	MED-A: 30; MED-B: >40	—
5	II	MED-A: 12	—
6	VI	MED-A: 3; MED-B: 48	—
7	VI	MED-A: 3; MED-B: 12	—
8	VI	MED-A: 8; MED-B: 6	Trimethoprim-sulfamethoxazole
9	IV	MED-A:30; MED-B:48	—
10	IV	MED-A: 15–30; MED-B: 72	—
11	V	MED-A: 12; MED-B: 36	—
12	II	MED-A: 30	—
13	VI	MED-A: 25; MED-B: 6	Ibuprofen
14	V	MED-A: > 6; MED-B: 48	—
15	VI	MED-A: 3; MED-B: 24	—
16	V	MED-A:15; MED-B: 40	—
17	I	MED-A:8; MED-B: 6	HCTZ
18	V	MED-A: 15	—
19	IV	MED-A: 8; MED-B: 6	—
20	V	MED-A: 8; MED-B: 72	St. John's wort
21	V	MED-A:3; MED-B: 12	—
22	VI	MED-A: 30; MED-B: 48	—
23	I	MED-A: 15; MED-B: 5	—
24	II	MED-A: 2; MED-B: 100	—
25	IV	MED-A: 30; MED-B: 200	—
26	IV	MED-A: 2	—
27	IV	MED-A: < 2; MED-B: < 100	ASA
28	I	MED-A: 15; MED-B: 100	—
29	V	MED-A: 8; MED-B: 250	—
30	II	MED-A: 9; MED-B: 70	—
31	I	MED-A: 15; MED B: < 100	—
32	III	MED-A: 15	—
33	III	MED-A: 8; MED-B: < 50	Ibuprofen
34	I	MED-A: < 8; MED-B: 300	—
35	V	MED-A: 30; MED-B: 6	ASA
36	V	MED-A: 6; MED-B: 80	—
37	IV	MED-B: 350	HCTZ
38	II	MED-A: 15; MED-B: 350	ASA
39	II	MED-A: 45; MED-B: 400	—
40	III	MED-A: 0.5	—

ASA = acetylsalicylic acid; HCTZ = hydrochlorothiazide; MED-A = minimal erythema dose to ultraviolet A; MED-B = minimal erythema dose to ultraviolet B.

Table 5. Most-Common Agents Eliciting Positive Patch-Test and Photopatch-Test Responses

Patch Tests		Photopatch Tests	
Agent	No. of Positive Responses (% of Total Positive Responses)	Agent	No. of Positive Responses (% of Total Positive Responses)
Carba mix	5 (12.8)	Avobenzone (Parsol 1789)	8 (18.2)
para-Phenylenediamine	3 (7.7)	Oxybenzone (BZP-3)	5 (11.4)
Neomycin sulfate	2 (5.1)	Musk ambrette	4 (9.1)
Thiuram mix	2 (5.1)	2,2'-Thiobis(4-chlorophenol) (fenticlor)	3 (6.8)
Quaternium-15	2 (5.1)	Bithionol	3 (6.8)
Bacitracin	2 (5.1)	2-Hydroxy-4-methoxybenzophenone-5-sulfonic acid (sulisobenzene, BZP-4)	2 (4.5)
Propylene glycol	2 (5.1)	Promethazine	2 (4.5)
Benzalkonium chloride	2 (5.1)	<i>Tanacetum vulgare</i>	2 (4.5)
		<i>Taraxacum officinale</i>	2 (4.5)
		Folpet	2 (4.5)

photopatch testing was 44; the mean number of allergic reactions per patient was 2.6. Of the photopatch-test reactions, 43.5% were caused by sunscreens, 17.4% by plants and plant derivatives, 15.2% by antimicrobial agents, 13.0% by fragrances, 6.5% by medications, and 4.6% by pesticides. The most common sunscreens eliciting positive photopatch-test reactions were avobenzone (Parsol 1789) (18.2%) and oxybenzone (11.4%). Among the plants, *Tanacetum vulgare* and *Taraxacum officinale* each accounted for 4.5% of the total positive photopatch-test reactions. Fenticlor and bithionol were the only two antimicrobials that elicited positive reactions (both 6.8%). Among fragrances, musk ambrette accounted for 9.1% of the positive phototest reactions (see Table 5).

Discussion

CAD is being diagnosed in an increasing number of patients at our center. From 1993 to 2009, 40 patients who were examined at the NYU Charles C. Harris Skin and Cancer Unit were assigned a diagnosis of CAD. Although CAD traditionally has been observed more commonly in men older than 50 years, we noted a greater percentage of younger patients and female patients. Chew and colleagues reported a similar observation regarding gender and identified a decrease in the percentage of male patients (from 78% to 72%).⁸ A comparison of demographics in 1994 and 2009 shows that the percentage of men declined from 71.4% to 67.5% overall and that 5 (55.6%) of the 9 patients who were less than 50 years of age were women. However, only 7 (22.6%) of 31 individuals older than 50 years were women.

Similar to seven young CAD patients in the United Kingdom,² the nine patients in our study who were less than 50 years of age had photosensitivity to both UVA and UVB or to UVA alone, and 7 of 9 individuals (77.8%) had skin types IV to VI. In individuals 50 years of age and older, only 17 of 31 (54.8%) had the same skin types. This observation suggests that although we are seeing an overall younger and female population with CAD, the increase in those with lighter skin types is attributable to the older male population of individuals with the disease. We can deduce a trend of two new classes of North American patients presenting at our institution who are being diagnosed with CAD: younger women with skin types IV to VI and older men with skin types I to III. Although no patterns are readily apparent when we review patch-test and photopatch-test results of patients younger than 50 years, perhaps the greater use of sunscreen by the fairer older male population can account for some of our observations. Studies have suggested an association between a diagnosis of CAD at a young age and human immunodeficiency virus (HIV) infection.⁹⁻¹¹ This observation has led to the suggestion that the idiopathic photosensitivity seen in CAD cases may be a late manifestation of HIV infection. However, of those CAD patients younger than 50 years in our study, only one woman had HIV infection.

About 70% of patients with CAD are expected to have allergic contact dermatitis or photoallergic contact dermatitis (PACD). In 66.7% of our patients with CAD, patch-test reactions were positive, and 58.1% had positive photopatch-test reactions. The majority (43%) of the positive photopatch-test reactions were caused by

Table 6. Summary of Selected Reports (n ≥ 4) on Chronic Actinic Dermatitis from 1993 to 2010

<i>Location</i>	<i>Study Period</i>	<i>n</i>	<i>Mean Age (yr)</i>	<i>No. of Male Patients (% of Total)</i>	<i>Skin Type (No. of Patients)</i>	<i>Most Frequent Allergens in Patch Testing</i>	<i>Most Frequent Allergens in Photopatch Testing</i>
Japan ¹³	1985–1991	6	64	6 (100%)	N/A	N/A	N/A
United Kingdom ¹²	1987–1992	89	66	69 (77.5%)	I–III (80); IV (1); V (6); VI (2)	Chromate, fragrance compounds, preservatives, rubber chemicals, metals, sesquiterpene lactone mix	Musk ambrette, oxybenzone, PABA
United Kingdom ²	1992–1996	7	22	6 (85.7%)	N/A	Amerchol 101, chrome, cobalt, colophony, daisy, formaldehyde, fragrance mix, nickel, tansy, wood alcohol	N/A
United States ¹⁴	1995–1996	9	62	6 (66.7%)	II (1); V (1); VI (7)	Atranorin, folpet (pesticide), lichen acid mix, musk ambrette, octyl dimethyl PABA, <i>Tanacetum vulgare</i> , Ti screen	Musk ambrette, PABA
Korea ¹⁵	1991–1997	11	50	10 (90.9%)	N/A	N/A	Balsam of Peru, chlorpromazine, promethazine hydrochloride, tetrachlorosalicylanilide (TCSA), trichlorocarbanilide, promethazine, 6-methylcoumarin
Australia ¹²	1993–2001	44	63	37 (84.1%)	N/A	Carba mix, cobalt, colophony, potassium dichromate, sesquiterpene lactone mix	Fragrance constituents, sunscreen constituents, wood mix
India ¹⁶	2004–2005	9	57	9 (100%)	N/A	Colophony, nickel sulfate, parthenium	N/A
Canada ¹⁷	N/A	4	51	4 (100%)	I (2); II (2)	Balsam of Peru, cobalt chloride, colophony, Compositae and sesquiterpene lactone, diglycidyl ether of bisphenol A, epoxy, fragrance, lanolin, PPD, resin	Avobenzone, lichen acid mix, oxybenzone, PABA
Korea ¹⁸	1991–2008	51	59.2	42 (82.4%)	N/A	Balsam of Peru, captan, cobalt chloride, formaldehyde, fragrance mix, ammoniated mercury chloride, nickel, paraben, potassium dichromate, thiuram, wool	Balsam of Peru, bithionol, promethazine HCl, perfume mix, chlorpromazine HCl, chlorhexidine digluconate, fenticlor, TCSA, PABA, hexachlorophene, wood mix

Table 6. Continued

Location	Study Period	n	Mean Age (yr)	No. of Male Patients (% of Total)	Skin Type (No. of Patients)	Most Frequent Allergens in Patch Testing	Most Frequent Allergens in Photopatch Testing
United Kingdom ⁸	2000–2005	50	63	36 (72%)	I–III (38); V (8); VI (4)	Colophony, fragrance mix I, nonfragrance consumer allergens, PPD, rubber chemicals, sesquiterpene lactone	N/A

HCl = hydrochloride; N/A = not available; PABA = para-aminobenzoic acid; PPD = para-phenylenediamine; TCSA = tetrachlorosalicylanilide.

sunscreen components. Sunscreens have previously been described as major allergens in PACD.⁵ In our study, avobenzone (Parsol 1789) was the most common sunscreen component to elicit a positive reaction. This may be explained by the more frequent inclusion of avobenzone in commercial sunscreens as well as the inclusion of sunscreens in cosmetics.

The second most common group of allergens that produce positive photopatch-test results consists of plants and plant derivatives. In other parts of the world, plants have frequently yielded positive photopatch-test results (Table 6)^{2,8,12–18}; this finding was less common in the United States, according to our previous study.¹ Furthermore, the plants that produced positive reactions were not the plants commonly identified in other studies. For example, sesquiterpene lactone, found in plants of the Compositae family and regarded as a common allergen for CAD patients in the United Kingdom^{8,12} and Australia,¹⁹ yielded only one positive response in this study, and all of the positive responses to the various plants were in the same five patients. Each of these patients had positive test results for an average of 1.8 plants, which suggested that positive reaction to plants and plant derivatives is not a widespread phenomenon among patients with CAD at our institution.

An allergen of particular interest is para-phenylenediamine (p-phenylenediamine), an aromatic amine found in hair dyes and henna tattoos.^{7,20} According to a recent study in the United Kingdom,⁸ there has been a substantial increase in positive patch-test reactions to p-phenylenediamine; 12% of all positive patch-test reactions are due to this agent. In our study, reactions to p-phenylenediamine were observed in 3 (16.7%) of 18 patch-tested patients and accounted for 7.7% of all positive patch-test results. By comparison, the NACDG found that 5% of 4,428 patients had positive patch-test reactions to p-phenylenediamine. The greatest percentage of positive results reported by the

NACDG was 6.8% in 1994 to 1996.⁷ All three positive reactions in our study were detected in 2009, which suggests a recently emerging allergen among patients with CAD. A 2002 study examining the effect of race and ethnicity on patch-test results found that African American patients exhibited higher rates of sensitization to p-phenylenediamine.²¹ In fact, the three individuals who had positive patch-test reactions to this allergen were men older than 50 years with skin types IV to VI. We are therefore unable to attribute this trend in our patients to the more global observation of an increase in the percentage of younger women or individuals with skin types I to III (other authors have suggested changes in exposure patterns owing to more young people dying their hair).⁸

Acknowledging the high percentage of patients (66.7%) with positive patch-test reactions to allergens at a greater number when compared to the general population, we recommend patch tests and photopatch tests as useful adjuncts in the assessment of patients with CAD.

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