

Acrylate Contact Allergy: Patient Characteristics and Evaluation of Screening Allergens

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Background: Acrylates are present in a wide variety of products and cause occupational and non-occupational allergic contact dermatitis. There is no clear guidance from the literature as to which allergens should be used for patch-test screening for acrylates.

Objectives: To characterize patients with contact allergy to acrylates and to evaluate the allergens used to screen for acrylate allergy.

Methods: Charts of patients visiting an outpatient contact dermatitis clinic from January 1998 to February 2008 were reviewed retrospectively.

Results: Forty-four patients were found to have contact allergy to acrylates. The most commonly positive allergens were hydroxyethyl methacrylate (HEMA), ethyl acrylate (EA), and methyl methacrylate (MMA). Thirty-two of the 44 positive patch-test results (73%) would have been discovered with the use of the two compounds (MMA, EA) in the North American Standard Series (Chemotechnique screening series), a commercially available screening series, while 12 were found through expanded patch testing. Artificial nails, dental materials, and adhesives were the most common exposures. Occupational relevance was found in 18 cases, including those of dental workers, assemblers, and aestheticians.

Conclusions: Acrylates are an important cause of contact allergy. Screening series identify most cases of acrylate allergy but miss a substantial number. Clinicians should remain vigilant for acrylate allergy even if initial screening is negative.

ACRYLATES are synthetic thermoplastics and resins present in a wide variety of products and are known causes of both occupational and non-occupational contact allergy. In a recent study using data from both Sweden and Singapore, the prevalence of acrylate allergy in a patch-tested population ranged from 1.0 to 1.4%.¹ Acrylates are formed by derivatives of acrylic acid; acrylic polymers are created by the addition of combinations of various monomers, including acrylic, methacrylic, and cyanoacrylic acids and their esters, acrylamides and acrylonitrile. Although these polymers are generally thought to be safe, the monomers themselves are potent contact sensitizers.

Common routes of exposure to acrylates are the use or handling of artificial nails, dental prostheses, dental cements and composite fillings, industrial glues, and ultraviolet-cured acrylic resin systems. Periungual dermatitis and nail dystrophy in a patient who uses artificial nails, or fingertip dermatitis in a patient working with any of the above

products, should prompt the clinician to consider acrylate allergy.² Additionally, fingertip paresthesias may be a sign of acrylate allergy.²

Although some relevant studies have been conducted, there is no clear guidance from the literature as to which acrylate monomers are best for contact allergy screening. At this point, the North American Standard Series (NASS)—a commercially available screening series from Chemotechnique Diagnostics (Vellinge, Sweden) used widely in North America—uses ethyl acrylate (EA) and methyl methacrylate (MMA). The North American Contact Dermatitis Group (NACDG) series contains those same two acrylates in addition to hydroxyethyl methacrylate (HEMA).

Objectives

Our objectives were to characterize patients with contact allergy to acrylates in an outpatient contact dermatitis clinic and to evaluate the allergens used to screen for acrylate allergy.

Methods

A retrospective chart review of patients attending the contact dermatitis clinic in Ottawa, Ontario, Canada, between January 1998 and February 2008 was conducted.

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All of these patients were patch-tested with the NACDG series of allergens, and many were tested with additional screening series (eg, nail series, dental series), depending on the clinical suspicion of the testing physician. Patch testing was performed with the Finn Chamber system (Epitest Ltd Oy, Tuusula, Finland). The allergens were supplied by Chemotechnique Diagnostics (Vellinge, Sweden). Patches were applied to patients' backs and were left on for 48 hours. Final patch-test readings were conducted at 96 hours.

The charts of patients who had a positive reaction to at least one acrylate allergen were analyzed. The following information was collected from these charts: demographic information (age, sex, and occupation), patch-test results, clinical relevance of the patient's acrylate allergy as interpreted by the patch-testing physician, and characteristics of the patient's eruption.

Data on the total number of patients patch-tested in the clinic from January 1998 through December 2007 were obtained from the NACDG.

Results

From January 1998 through February 2008, the charts of 44 patients who had a positive reaction to at least one acrylate compound were reviewed; 37 patients were female, 7 were male, and the mean age was 47 years (range, 16–75 yr). From January 1998 through December 2007, a total of 3,991 patients were patch-tested in the clinic.

Exposure to artificial nails (14 patients) and dental materials (9 patients) were the most common exposures responsible for contact allergy to acrylates (Table 1). (One patient had separate clinical reactions to artificial nails, dental prostheses, and feminine hygiene pads and is therefore counted three times in Table 1).

The most common occupation of patients in this study was that of office worker (8 patients), followed by nurse (6 patients); however, none of those patients had occupationally relevant contact dermatitis. The five dental workers (1 dentist and 4 dental assistants), the assemblers (4 patients), and the aestheticians (4 patients) did have occupationally relevant acrylate allergy. Data regarding the occupations of the patients in this study are presented in Table 2.

The three allergens used in the NACDG screening series—HEMA, EA, and MMA (to which 30, 28, and 25 patients, respectively, reacted positively)—were the allergens that were most commonly positive on patch testing. Ethylene glycol dimethacrylate (EGDMA) was also frequently positive (20 patients). Patients tested positively to many other acrylate allergens, but none of the other allergens were positive in more than five patients. One patient, an aesthetician working with artificial nails, reacted to EA and also reacted to ethyl cyanoacrylate. This was the only case of co-reactivity with cyanoacrylates in our series.

HEMA (10 patients), MMA (8 patients), EA (7 patients), and EGDMA (5 patients) were most frequently positive among the 14 patients with artificial nail-related contact dermatitis as well. The allergens found to be positive most frequently for other routes of exposure to acrylates are listed in Table 1.

The use of EA and MMA (NASS allergens) alone would have resulted in patch-test positivity in 32 patients (73%). The addition of HEMA to those two allergens, as in the NACDG series, resulted in positivity in 40 patients (91%). The remaining 9% of patients were only found to be positive with the use of extended series of allergens. No individual allergen (including EGDMA) in the various expanded series would have led to the identification of more than one extra case of acrylate allergy.

Table 1. Exposures Responsible for Contact Allergy to Acrylates

<i>Exposure Route</i>	<i>No. of Patients</i>	<i>Commonly Implicated Allergens (No. of Patients)</i>
Artificial nails	14	HEMA (10), MMA (8), EA (7), EGDMA (6)
Dental products	9	HEMA (8), MMA (5), TFDMA (5), EA (8)
Adhesives	5	HEMA (5), EA (3), EGDMA (3)
Auto mechanics' products	2	EA (1), TEGDMA (1), BGMA (1)
Feminine hygiene pads	2	HEMA (2), EA (2)
Leg prostheses	1	MMA (1), EA (1), HEMA (1), EGDMA (1)
Microscope compounding resins	1	MMA (1), EA (1)
None documented or found	12	—

BGMA = bisphenol A glycidyl methacrylate; EA = ethyl acrylate; EGDMA = ethylene glycol dimethacrylate; HEMA = hydroxyethyl methacrylate; MMA = methyl methacrylate; TEGDMA = triethylene glycol dimethacrylate; TFDMA = tetrahydrofurfuryl methacrylate.

Table 2. Occupations of Patients with Contact Allergy to Acrylates

Occupation	No. of Patients	No. (Percent) of Occupationally	
		Relevant Cases	Commonly Implicated Allergens (No. of Patients)
Office worker	8	0 (0)	EA (7), HEMA (5), MMA (5)
Nurse	6	0 (0)	MMA (5), HEMA (4), EA (3)
Dental worker	5	5 (100)	HEMA (5), EGDMA (4), TFDMA (3), MMA (2)
Fiber optics assembler	4	4 (100)	EA (3), HEMA (3), EGDMA (2)
Aesthetician	4	4 (100)	HEMA (4), EGDMA (3), HPMA (2)
Auto mechanic	3	3 (100)	EA (2), TEGDMA (1), BGMA (1)
Physician	1	1 (100)	MMA (1), EA (1)
Artist	1	1 (100)	MMA (1), HEMA (1), EA (1), EGDMA (1)
Firefighter	1	0 (0)	HEMA (1)
Unemployed	1	—	—
Data unavailable	10	—	—
Total	44	18 (41)	HEMA (30), EA (28), MMA (25), EGDMA (20)

BGMA = bisphenol A glycidyl methacrylate; EA = ethyl acrylate; EGDMA = ethylene glycol dimethacrylate; HEMA = hydroxyethyl methacrylate; HPMA = hydroxypropyl methacrylate; MMA = methyl methacrylate; TEGDMA = triethylene glycol dimethacrylate; TFDMA = tetrahydrofurfuryl methacrylate.

Discussion

In clinical practice, acrylates are an uncommon but important cause of contact dermatitis. In just over 10 years, we had 44 patients who were patch test positive to acrylates; 32 of these patients had a documented clinically relevant exposure to acrylates. During roughly the same period, 3,991 patients were patch-tested in the clinic. This gives a 1% estimated incidence of acrylate allergy in our patch-tested population.

Of those patients whose positive reactions were clinically relevant, 27 (84%) had reactions that were related to three of the most common causes of acrylate allergy: artificial nails, dental materials, and adhesives. However, there were patients who did not have a clinical history classic for acrylate allergy. That fact emphasizes the continued need to include acrylates in general screening series.

Although the majority of patients in this study did not have occupationally relevant contact allergy to acrylates, 18 (41%) of the patients did. Not surprisingly, patients who handled dental materials (dentists and dental assistants) or artificial nails (aestheticians) in the workplace were among those with occupationally relevant contact dermatitis. Fiber optics assemblers with occupationally relevant acrylate allergy were also highly represented in our cohort. Although this finding is interesting and should prompt clinicians to be suspicious of acrylate allergy in that population (as those workers can be exposed to acrylates in adhesives), fiber optics assemblers are likely over-represented in this study because of a regional fiber optics company's referral of many of its employees to our clinic for assessment. Although there were many nurses and office

workers in this study, none of them had contact dermatitis that was relevant to their occupation.

The top three allergens in our screening group were EA, MMA, and HEMA. This accords with some of the recent literature on patch testing with acrylates, but other studies have had differing results. A similar study by Sood and Taylor found that 2-hydroxypropyl methacrylate, EGDMA, and HEMA were the most commonly positive allergens.³ One series focusing on nail-specific contact dermatitis found that EGDMA, HEMA, and triethylene glycol diacrylate were most commonly positive, whereas another found that EGDMA, HEMA, and hydroxyethyl acrylate were the most common.^{4,5} A study that looked at dental-related acrylate allergy found that HEMA, EGDMA, and triethylene glycol dimethacrylate (TEGDMA) were the most commonly positive allergens.⁶ It should be noted that most (but not all) of our cases with positive patch-test reactions to MMA occurred in the early years of our study, and such cases have decreased since MMA was banned from artificial nail products.

Our results regarding the frequency of positivity among the various screening allergens beg the question of whether the NASS and the NACDG screening series screen adequately for acrylate allergy. Had our clinic used only the NASS (which includes EA and MMA), 27% of cases of acrylate allergy would have been missed—12 cases during the roughly 10-year span of the study. Although the screening proficiency of the NACDG series, which benefits from the inclusion of HEMA, was significantly better than that of the NASS, the NACDG series still fell short in 9% of cases (4 patients during 10 years). These data may indicate a need to consider adding HEMA to the NASS, which is

often the only series used by clinicians in North America for screening. Improving the sensitivity of the NACDG series would be ideal as well, but we did not identify any one allergen that could efficiently do so.

Our study is limited by a number of factors. First, we performed a retrospective chart review; as such, data from some patients are missing, and we may not have identified every patient with acrylate allergy seen in the clinic. Second, our data regarding the total number of patch-tested patients do not encompass the exact time frame of our retrospective review. One confounding factor in our results is that not all patients were patch-tested with identical regimens. Extended screening series were used only with some of our patients; as such, the true prevalence of positivity of some of the compounds (such as TEGDMA) cannot be calculated. Implementing a “gold standard” for detecting acrylate allergy would require patch-testing each patient with every available acrylate compound. Because this was not done in our study, the sensitivity of various allergens and screening series cannot be calculated. Nevertheless, our study does demonstrate that the various screening series used—particularly the NACDG series, which contains MMA, EA, and HEMA—are effective. However, it also highlights the need for expanded series including nail and dental series as indicated by clinical history and the judgment of the patch-testing physician.

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