

Acrylate Systemic Contact Dermatitis

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Abstract: Acrylates, the 2012 American Contact Dermatitis Society allergen of the year, are found in a range of products including the absorbent materials within feminine hygiene pads. When fully polymerized, acrylates are nonimmunogenic; however, if not completely cured, the monomers can be potent allergens.

A 28-year-old woman is presented, who had her teeth varnished with Isodan (Septodont, Saint-Maur-des-Fossés, France) containing HEMA (2-hydroxyethyl methacrylate) with no initial reaction. Approximately 1 month later, the patient developed a genital dermatitis secondary to her feminine hygiene pads. The initial reaction resolved, but 5 months later, the patient developed a systemic contact dermatitis after receiving a second varnishing.

The patient was dramatically patch test positive to many acrylates. This case demonstrates a reaction to likely unpolymerized acrylates within a feminine hygiene pad, as well as broad cross-reactivity or cosensitivity to acrylates, and possibly a systemic contact dermatitis with systemic re-exposure to unpolymerized acrylates.

CASE REPORT

A 28-year-old woman presented for patch testing after seemingly inexplicable episodes of acute papulovesicular eczematous dermatitis. Her first episode involved her suprapubic and genital area while wearing Kotex Lightdays pantliners. The eruption progressed to spread symmetrically to her arms and legs over the course of 10 days. She received a course of oral prednisone for 4 days as well as hydrocortisone 1% cream from her primary care doctor and the reaction eventually calmed within weeks but did not clear completely. The patient did not use the pads again. Her second episode followed 5 months later after a second varnishing of her teeth to reduce dentin hypersensitivity with Isodan (Septodont, Saint-Maur-des-Fossés, France). The first varnishing was performed 1 month before the initial genital episode. Within 24 hours of the second varnishing, the patient experienced gingival inflammation, hyperemia, and ulcerations on her buccal mucosa and gingiva. This once more became widespread symmetrically on her trunk and extremities and lasted over 4 months.

The Kotex Lightdays pantliner consists of a polypropylene cover, an intake layer of wood pulp and polyethylene/polyester fiber, and an absorbent layer that includes polyacrylate. Isodan's material safety data sheet states the ingredients as follows: 2-hydroxyethyl methacrylate (HEMA), potassium nitrate, and sodium fluoride. An allergic contact dermatitis to acrylate was suspected, and the patient was patch tested

to the North American Contact Dermatitis Group (NACDG) standard screening series using Finn Chambers (AllergEAZE; SmartPractice, Phoenix, Ariz) and Scanpor tape (Norgesplaster Alpharma, Vennessla, Norway), as well as select other series (Table 1) using IQ Chambers (Chemotechnique Diagnostics, Malmö, Sweden). She was also tested to dry and wet pieces of the various layers of the Kotex pad and Tampax tampons (Procter and Gamble); however, the pad was not from the original box containing the pad that she reacted to. Patches were placed for 48 hours with a final reading at 96 hours. The patient had dramatic results to patch testing with positive reactions to many acrylates (Table 2). She was not positive to the Kotex or Tampax products tested except for an irritant reaction to the damp Kotex products; however, the original packages had been discarded. Therefore, a new package of the same brand was purchased for testing. The NACDG scoring protocol was used.¹

Based on the history and patch testing results, the following was surmised. The patient was sensitized to acrylate at her initial teeth varnishing with Isodan that contained HEMA. This semimucosal exposure may have resulted in systemic absorption. Approximately 1 month later, during the patient's menses, she was unfortunately exposed to a feminine pad containing a super-absorbent substance composed of polyacrylates that likely were not fully polymerized, resulting in a local allergic contact dermatitis in her suprapubic and genital area followed by a widespread autoeczematous reaction. The patient then unknowingly re-exposed herself to acrylate at her second varnishing approximately 5 months after her initial reaction resulting again in a local allergic contact dermatitis within her mouth followed by either a widespread autoeczematization or a systemic contact dermatitis lasting months. It was concluded that the negative patch testing to the Kotex product was due to a different batch of the product, as the tested product was not from the original box that the patient reacted to.

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DISCUSSION

Acrylates, the 2012 American Contact Dermatitis Society allergen of the year, are found in a range of industries and products including paints, adhesives, cosmetics, artificial nails, dental products, medical products, and in any types of hard plastic surface such as windowpanes, car lights, helmet visors, aquarium panels, and more.² In a study over 10 years with 27 clinically relevant positive patch tests to acrylates, the most common sources were artificial nails, dental materials, and adhesives.³ Acrylates are plastics that can be molded with high temperatures. Monomers (acrylic or methacrylic acid) can be combined through polymerization (polyacrylates) to create stronger bonds and as such stronger materials. Fully polymerized acrylates are thought to be safe and unable to cause allergy.⁴ However, monomers can be strong irritants and allergens. Small amounts of (meth)acrylates can often be found within the lattice of polyacrylates but are usually insufficient to cause allergy.⁵ This case highlights a reaction to a polymerized product likely not fully cured and the cross-reactivity or cosensitivity to many other acrylates, and this case is the first reported systemic contact allergy to acrylates.

Acrylates are a component of the North American Standard Series of patch tests. Specifically, methyl methacrylate, ethyl acrylate, and hydroxyethyl methacrylate are tested across all patients. Using these allergens, 91% of relevant allergens may be found.² Exposure to polyacrylates typically does not sensitize patients, yet exposure to various monomers can sensitize patients to other similar acrylate monomers. This sensitization phenomenon is referred to as cross-reactivity. However, Kanerva et al⁶ demonstrated that the material safety data sheets of products containing methacrylates also contained undisclosed amounts of other acrylates in concentrations as high as 46%. Thus, patients with positive patch test reactions to a variety of acrylates may have actually been cosensitized to undisclosed acrylates not listed in products containing the allergen. Without sophisticated testing to identify acrylates contained within products,^{6,7} it is not possible to state if a patient with broad reactivity to acrylates represents cross-reactivity to other similar acrylates or represents cosensitization to undisclosed unrelated acrylates in the product. As such, whether this case represents cross-reactivity or cosensitivity cannot be determined, as further testing on Isodan to identify the presence of unlisted acrylates was not performed.

TABLE 1. Allergens Tested

The NACDG standard screening series
Select acrylates in the adhesive screening series
Select vehicles and preservatives in the cosmetic screening series
Sunscreen screening series
Flavors and fragrances screening series
Several of the patient's own pads, wet and dry pieces from various layers; however, the original box of Kotex Lightdays pantliners that the patient had a reaction to was not available for testing

TABLE 2. Patch Test Results

Allergen	Abbreviation	Reaction
Methylmethacrylate	MMA	3+
Hydroxyethyl methacrylate	HEMA	3+
Butyl methacrylate	BMA	3+
Hydroxypropyl methacrylate	HPMA	3+
Ethylene glycol dimethacrylate	EGDMA	3+
Triethylene glycol dimethacrylate	TEGDMA	3+
Butanediol dimethacrylate	BDDMA	3+
Urethane dimethacrylate	UDMA	3+
Hexanediol diacrylate	HDDA	3+
Tetrahydrofurfuryl methacrylate	TFDMA	3+
Triethylene glycol dimethacrylate	TEGDMA	3+
Dimethyl ethyl methacrylate	DMEMA	1+
Tripropylene glycol diacrylate	TPGDA	3+
Trimethylolpropane triacrylate	TMPTA	3+

Acrylate allergy within absorbent diaper or feminine hygiene pad products is rare. Giroux and Pratt⁸ reported the first case of patch test–positive contact dermatitis to Poise incontinency pads (inner and outer layers) with pertinent positives to multiple (meth)acrylates. Giroux and Pratt⁸ suggested several mechanisms of allergic transformation of the polyacrylates within the pads including (1) incomplete polymerization leading to exposure to uncured monomers, (2) trace unpolymerized monomers within the final product, (3) release of monomers from polymers by shearing forces and microscopic physical damage, and (4) movement of acrylates into a solution.⁸ All of these mechanisms are plausible for the reported case. Because the patient in this article did not react to the patch testing of the Kotex pad from a different box, it is possible that her initial reaction was due to batch-to-batch variations via proposed mechanisms 1 or 2. Drucker and Pratt³ subsequently reported 2 more cases of acrylate allergy from feminine hygiene pads in a case series of acrylate contact allergy; however, one of these cases may have been the same one reported in the study by Giroux and Pratt.⁸ Further review of the literature did not demonstrate other cases of acrylate allergy from absorbent or feminine paper products.

Various occupations and patient populations are exposed to acrylates and can present in different ways with allergic contact dermatitis (Table 3). To date, no cases of systemic contact dermatitis to (meth)acrylates have been reported. Systemic contact dermatitis is a widespread cutaneous eczematous allergic eruption resulting from either systemic or cutaneous sensitization followed by systemic (subcutaneous, intravenous, intramuscular, inhalation, or oral ingestion) elicitation.⁹ Examples of systemic contact dermatitis include topical ethylenediamine hydrochloride with oral aminophylline or hydroxyzine, topical thiuram with oral tetraethyl thiuram disulfide (Disulfiram), topical thimerosal with oral piroxicam, and others.¹⁰

Fitzgerald and English¹¹ reported a widespread, patch test–positive allergic contact dermatitis to sculptured nails presenting with

TABLE 3. Common Exposures and Presentations of Acrylate Allergic Contact Dermatitis

Category	Patient	Sources	Symptoms
Dental	Dentist, dental technicians, orthodontists	Prosthetics, cements, and fillings	Airborne (face, eyelids, hands, and arms) ± immediate hypersensitivity (rhinitis, conjunctivitis, or airway obstruction) but skin prick negative
Dental Adhesives	Patients Manufacturers	Prosthetics, cements, and fillings Anaerobic sealants, electric or electronic assembly, paints	Gingival and perioral dermatitis Exposed skin on hands, arms, and face
Printing	Print workers	UV-cured ink	Exposed skin on hands, arms, and face
Cosmetics	Aestheticians and customers	Artificial nails, nail glue, UV-cured nail polish	Periungal dermatitis; nail dystrophy; dorsal hands; local exposure to face, eyelids, and neck; parosethia
Medical	Orthopedic surgeons and nurses	Bone cement	Paresthesia, pulp of fingers
Medical	Diabetic patients	Insulin pumps	Infusion sites
Medical	Hearing loss patients	Hearing aids	Ears
Personal products	Females	Feminine paper products	Genitals

involvement of the hands, arms, trunk, and face that could mimic a systemic contact dermatitis but likely represented an autoeczematization reaction as there was no systemic exposure to acrylates. The patient was patch test positive to ethyl methacrylate, polymer nail powder, and butyl methacrylate. There were 2 case reports of acrylates causing systemic symptoms including nausea, vomiting, diarrhea, fatigue, and headache but neither included a widespread distribution of cutaneous manifestations. First, Mathias et al¹² presented a 28-year-old laboratory technician working with HEMA that experienced hand dermatitis with paresthesia as well as nausea and diarrhea. The patient was patch test positive to HEMA, methylmethacrylate, ethyl methacrylate, propyl methacrylate, and isopropyl methacrylate. The authors concluded that most systemic symptoms were due to inhaled vapors but could represent an unusual allergic manifestation of contact allergy. Second, Andersen¹³ presented a 30-year-old woman who experienced systemic symptoms while working with HEMA, hydroxyethyl acrylate, and ethylene glycol dimethacrylate in the production of disposable acrylate contact lenses. The only cutaneous manifestation was onycholysis in addition to fatigue, gastrointestinal symptoms, and irregular menses. Patch testing was not completed on the patient due to the systemic symptoms elicited after 18 hours, and there were no positive reactions at 48, 72, or 144 hours. In addition, it has been demonstrated that methacrylates can cause asthma and rhinoconjunctivitis¹⁴; however, there have been no reports of widespread cutaneous eruptions. Thus, the case presented may either represent a widespread autoeczematization or may be the first case of an acrylate causing a systemic contact dermatitis as demonstrated by the long-lasting widespread dermatitis. Without chemical analysis of the original Kotex pad to identify unpolymerized acrylates within the superabsorbent material of the particular batch in question, a definitive conclusion regarding

autoeczematization versus systemic contact dermatitis for the second elicitation reaction cannot be made.

CONCLUSIONS

This case demonstrates several unique characteristics of acrylate contact allergy. First, it is the second case reported of likely unpolymerized acrylates within an absorbent material. Second, it demonstrates either the likely contamination of other acrylates within products not otherwise listed on the material safety data sheet (cosensitization) or a broad cross-reactivity to other acrylate monomers. Finally, the case may either represent a widespread autoeczematization or may be the first reported case of a systemic contact dermatitis with sensitization through the oral semimucosa from teeth varnishing that resulted in a systemic contact dermatitis from systemic re-exposure.

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