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Contact dermatitis to cosmetics, fragrances, and botanicals

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ABSTRACT: Cosmetics, fragrances, and botanicals are important causes of allergic contact dermatitis. Identifying and avoiding the causative allergens can pose a challenge to both the patient and the dermatologist. The site of involvement can give the investigator clues to the cause of the eruption in many cases. Fragrances and preservatives are the two most clinically relevant allergens in cosmetics. Botanicals are being added to cosmetics because of consumer demand and are now being recognized as sources of allergy as well. Patch testing allows for the detection of allergens that are potentially relevant in the genesis of the patient's eczema. Common skin-care product allergens, including fragrances and botanicals as well as those found in sunscreen, nail, and hair-care products, are reviewed. Practical methods of allergen avoidance are also discussed.

KEYWORDS: allergy, botanical, contact dermatitis, cosmetics, fragrance

Introduction

Most individuals can use cosmetic products without difficulty. Modern formulations are specially designed to be tolerable and elegant for consumers. However, despite intensive efforts utilized to formulate hypoallergenic products, there is a small percentage of irritant and allergic contact dermatitis (ACD) that occurs with cosmetic use. The overall incidence of dermatitis produced by cosmetics is difficult to determine. If the consumer experiences a reaction that is mild and transient, they will not usually report the reaction or seek medical care. Typically, the patient will simply stop using the suspected product. In addition to eczema caused by a delayed-type hypersensitivity mechanism, contact urticaria may also be less commonly seen with cosmetic use via a type I immune-mediated or non-immunologic mechanism. It is of note that the occasional patient may experience burning, stinging, or itching without visible skin lesions.

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Fragrances are important sources of ACD. Fragrances are found in many cosmetics, as well as more traditionally in perfume or cologne form. Fragrances, including fragrance mix, balsam of Peru, and cinnamic aldehyde are the most commonly identified allergens in cosmetic-induced ACD (1). Specific fragrance allergen avoidance is complicated by the fact that manufacturers are not required to disclose the exact fragrance ingredients in products. Moreover, when a product lists "essential oils" as an ingredient, patients may not recognize this as fragrance.

Another important cause of contact dermatitis caused by cosmetics is the variety of preservatives added to the cosmetic products to maintain freshness. There are a number of preservatives used in cosmetics that can cause eczema in the sensitive consumer. Formaldehyde releasers (i.e., agents that slowly liberate small amounts of formaldehyde), methylchloroisothiazolinone/methylisothiazolinone (MCI/MI), and parabens are among the most widely used preservatives and are frequent allergens. Other important causes of contact allergy include the active ingredients found in hair- and nail-care products, such as permanent wave solutions, permanent hair coloring, artificial nails, and nail polishes.

Table 1. Common causes of contact allergy based on anatomical site

Site of involvement	Common source of allergen exposure
Face	Skin-care products: moisturizers, sunscreens, makeup, cleansers, and perfumes
Eyelids	Eye cosmetics and nail cosmetics
Lips and mouth	Lipsticks, oral hygiene products (e.g., toothpaste, mouthwash, and dental floss), gum, and mints
Ears	Hair-care products, perfumes, medicinal ear drops, and jewelry
Trunk	Moisturizers, sunscreens, cleansers, and perfumes
Hands	Moisturizers, cleansers, perfumes, and nail-care products
Scalp	Hair dyes, permanent waves, shampoos, hair sprays, and perfumes

Natural botanical extracts are increasingly utilized in a variety of skin-care items. Little is written about the use of botanicals and their association with contact dermatitis. It is of note that cosmetic-intolerant patients may be particularly drawn to the more "natural" botanical products, which may also contain preservatives and fragrance. Additionally, a variety of plant-containing substances and plants themselves are being applied to the skin for medicinal purposes. Aromatherapy is also an important source of fragrance that the patient may not think to include in their contact history.

History and physical exam findings

Allergic contact dermatitis to cosmetics and personal-care products can be found on any body area. A detailed history of items used and a thorough physical examination can provide clues for the observant clinician to unlock the mystery of ACD.

The physical exam can offer important clues to the cause of the eruption in most cases. For common causes of contact allergy based on anatomic site, please refer to Table 1.

Face

The face is a classic area of involvement for contact dermatitis to cosmetics, but virtually any body surface may be involved. Although the face is exposed to airborne allergens and irritants, skin-care products are the most common cause of facial dermatitis (2). Many different items are applied to the face each day, making this area of the body the most likely area to contact a variety of allergens including fragrances, preservatives, botanicals, and sunscreens. Sunscreens can cause photocontact dermatitis, as can aero-allergens, such as plants. Atopic dermatitis can also cause facial dermatitis and should be considered in the differential diagnosis. Irritant contact dermatitis is yet another cause of facial eczema that can be caused by cleansers, astringents, acne medications, and rejuvenating creams, for example. That said, an atopic background does not rule out allergic or irritant contact dermatitis as a cause for flare of facial or body dermatitis, and therefore, patch testing should be considered for these patients.

Eyelids

The eyelids are particularly susceptible to contact dermatitis and may be the first part of the body to show signs of allergic reaction to a product. The eyelids are most often affected by fragrances or preservatives found in cosmetics. The clinician should also consider aerosolized products, such as hair spray or cologne, when taking the history. Another common cause of eyelid dermatitis is fingernail polish. The fingers, because of their thicker skin, may demonstrate no signs of ACD, or may show a slight erythema and swelling at the lateral nail folds. Patients may be surprised that nail polish or items on the hands may be affecting their eyelids while not causing inflammation of their hands.

Additional exposures that can cause eyelid dermatitis are nickel and rubber allergens. These compounds may be found in eyelash curlers and makeup applicators. A history of sensitivity to costume jewelry, especially earrings, as well as intolerance to rubber-containing items, such as undergarments, may provide clues to the diagnosis. Atopic dermatitis frequently affects the eyelids, and chronic rubbing can heighten eyelid eczema. Patients with atopic dermatitis can frequently have a flare of eyelid dermatitis, especially with seasonal changes. Psoriasis can affect the lids as well but is less common. Infection should be considered since conjunctivitis and blepharitis may present with injected conjunctiva and erythematous eyelids, yielding a similar clinical picture to

contact dermatitis. Connective tissue disease, classically dermatomyositis, can lead to erythema and swelling of the eyelids but usually has a more violaceous hue. The patient's medication history should also be reviewed for possible photosensitizing medications, albeit that photodermatitis from an ingested medication is a less common source of eyelid erythema and swelling.

Lips and mouth

In some patients with cosmetic sensitivity, the lips and mouth may be the primary sites of involvement. If this is the case, the clinician should consider lipstick or lip balm ingredients, foodstuffs including flavorings, and oral hygiene products. Sunscreen in lip products may be a source of either an allergic contact reaction or a photo-allergic contact reaction. Flavorings in oral hygiene products can affect fragrance-allergic patients because some ingredients, such as cinnamic aldehyde, act as both fragrance and flavoring.

A sore mouth can be caused by ACD, and patch testing may be helpful. A physical exam may demonstrate erosions, bright erythema of the gums or erythema, and loss of the papillae on the tongue. However, relevant oral contact allergy can also occur with a normal-appearing oral mucosa.

Ears

Ears are not typically affected as an allergic site of involvement unless the patient is using a product only on the ears. Atopic dermatitis frequently involves the ears, as well as seborrheic dermatitis and psoriasis. Fragrances, lanolin, and topical medicaments such as neomycin are important antigens in the genesis of ear dermatitis, just as for other sites. Earlobe dermatitis is frequently caused by jewelry as well, most commonly nickel, but cobalt and gold may be alternative causative allergens.

Trunk

The trunk can be involved in ACD caused by cosmetics containing fragrances and botanicals as well. Patients may present with a widespread dermatitis because most personal-care products contain the two most common offenders: fragrances and preservatives (1). Shampoos, conditioners, hair sprays, body soaps, lotions, creams, and sunscreens are all items that may contain fragrance and preservatives and that have contact with a wide body surface area. The differential diagnosis for a widespread contract dermatitis also includes clothing-related allergens including textile dyes or formaldehyde-based, durable-press finishes. Rarely, a fragrance-sensitive patient may erupt because of fragrance in laundry detergent or fabric softeners.

One should also consider widespread dermatitis occurring because of a sympathetic reaction when one area of the body has severe ACD, as in the "excited skin syndrome." For example, if a patient has a severe acute allergic contact reaction to a perfume at the original site of application such as the neck, they may develop a widespread, but less severe, reaction over the trunk and extremities. The excited skin syndrome may also be seen when a patient is patch tested, producing a strong reaction to one or more antigens, with numerous other antigens showing lesser responses.

Hands

Allergic contact dermatitis affecting the hands may be related to occupational or avocational exposures, such as gloves, solvents, or plants. However, skin-care products, including soaps, moisturizers, and topical medications that may contain preservatives, fragrance, botanicals (or other active ingredients) may cause or contribute to the eruption. Clues to the differental diagnosis of hand dermatitis based on pattern of involvement can be elucidated on physical exam. Irritant contact dermatitis is often seen on fingertips and under rings. If the dorsal hands are the most involved, one should consider contact and atopic dermatitis. The interdigital skin is often affected by contact dermatitis, pompholyx, and systemic contact dermatitis. Characteristically, pompholyx, atopic dermatitis, dermatophyte infection, and psoriasis demonstrate palmar involvement. Contact dermatitis may be less common on the palms, without dorsal hand involvement, because of the thicker epidermis making it more difficult for allergens or irritants to penetrate. However, once the barrier has been broken, perhaps by an irritant dermatitis, commonly used products may become allergens. Frequent hand washing can lead to an irritant dermatitis of the hands, thus causing a disrupted barrier, allowing allergens to penetrate and begin the process of ACD.

Scalp

In this area, common sources of contactants include hair colorant and permanent wave solutions. There is often facial involvement when one

of these products is the cause of contact allergy. The scalp has relatively thick skin and will not react as readily as the thin skin of the neck, face, and eyelids. Scalp products may contribute to occupational hand dermatitis seen in hairdressers. Other causative allergens in scalp dermatitis include preservatives and fragrances found in personal-care items.

Common skin-care product allergens and their uses

Cosmetics contain a number of potential allergens. Fragrances are the most common cause of cosmetic contact allergy, while the second most common category of cosmetic allergens is preservatives (see Table 2) (1). Consumers who become allergic to these allergens can have widespread eruptions with significant morbidity. It often becomes necessary to patch test these patients to discover their allergies and assist them in avoidance. Prepared series of allergens include the TRUE Test®, which consists of 24 allergens (www.truetest.com). Customized series such as the North American Contact Dermatitis Standard Screening Series with 65 allergens and the Mayo Clinic's Standard Series with 73 allergens must be manually assembled (Chemotechnique, www.dormer.com) and are not approved by the US Food and Drug Administration. The Contact Allergen Replacement Database (CARD), discussed later, can be a helpful tool for the clinician to assist these patients in finding products free of their patch-test-identified allergens.

Table 2. North American Contact Dermatitis Group (NACDG) reaction rate data (1998–2000) for skin-care product allergens only

Allergen	NACDG reaction rate data (1998–2000) (%)
Balsam of Peru	12.3
Fragrance mix	11.7
Thimerosal	10.8
Formaldehyde	9.3
Quaternium-15	9.0
p-Phenylenediamine	4.9
p-Aminobenzoic acid	3.2[a]
2-Bromo-2-nitropropane-1,3-diol (Bronopol)	3.1
Imidazolidinyl urea	2.5
Lanolin alcohol	2.4
Glyceryl thioglycolate	2.0
DMDM hydantoin	1.9
Kathon CG	1.4
Toluene sulfonamide formaldehyde resin	1.3
Methyl methacrylate	1.3
Parabens	1.0
Oxybenzone	0.6

[a]Data for 1992–1998.

Fragrances

Fragrances have been used since ancient times. They are ubiquitous in the natural environment and in manufactured items. Fragrances are found today in cosmetics, perfumes, cleaning supplies, medicaments, and industry. Foods also contain aromatic compounds not for fragrance but for flavoring. They can be naturally derived from plants or synthesized in laboratories. Over 5000 different fragrance chemicals have been reported. Fragrance is the most common cause of ACD caused by personal-care products according to the North American Contact Dermatitis Group (NACDG) 1998–2000 patch-test results (1). FIG. 1 demonstrates contact allergy in a patient who was patch-test positive to fragrance mix. This allergen was deemed relevant when the patient cleared upon discontinuing sunscreens and soaps containing fragrance. Identifying the specific chemical fragrance causing the allergy is less important

FIG. 1. Subacute dermatitis in patient with a positive relevant reaction to fragrance mix and cinnamic aldehyde.

than identifying that the patient is fragrance allergic because most products or perfumes have a combination of different aromatic chemicals, and manufacturers are not required to list each specific fragrance component.

Because of the prevalence of allergic reactions to fragrance, a screening panel of the most common fragrance allergens has been created. Larsen identified a mixture of fragrances that could identify 80% of individuals with fragrance allergy (3). This mixture includes cinnamic aldehyde, cinnamic alcohol, geraniol, eugenol, isoeugenol, oak moss absolute, hydroxycitronellal, and alpha-amyl cinnamic alcohol and caused positive patch-test reactions in 11.7% of NACDG patients (1). These compounds are tested on the European standard series, NACDG standard series, and as part of the TRUE Test®. If sandalwood oil, narcissus absolute, and ylang-ylang oil are added to this series, then up to 95% of fragrance allergic patients can be identified (4).

After the relevance of the fragrance allergy is established, the patient should avoid all products that contain fragrance or scent in the ingredient list indefinitely. Patients determined to resume fragrance use after their eczema has cleared may assess the safety of using a fragrance containing product by performing a use test, which consists of applying the product to the inner forearm twice a day for one week. If there is no reaction, then they may begin using the product cautiously. An alternative to the open-use test is the employment of an expanded fragrance series. With this testing, if the patient is sensitive to only a single or limited number of fragrances, avoidance of those particular fragrances may allow the successful use of others. Nevertheless, because of the fact that fragrance components are not required for package labeling, it is essentially impossible for a patient to knowledgeably avoid a particular fragrance ingredient. For example, fragrance series patch testing may identify that a patient is sensitive to narcissus absolute, but this benefits them little since package labels indicate only that the product contains "fragrance." Alternatively, if the fragrance series patch tests show no reaction (e.g., to the fragrances lyral and synthetic jasmine), the patient may choose to seek out a custom perfumery for a cologne made of these ingredients alone.

Balsam of Peru

Balsam of Peru is a natural mixture of aromatic chemicals produced from a tree in Central America called *Myroxylon pereirae*. It has a pleasant odor from cinnamein- and essential-oil-containing cinnamic acid and vanillin (2). Balsam of Peru is used in cosmetics, pharmaceuticals, and flavorings. It also has antibacterial, antifungal, and antiscabetic activity. It is tested with the fragrance mix as a screening for fragrance sensitivity. The NACDG found that 12.3% of patients were allergic to this antigen (1). Balsam of Peru is either chemically related to or contains other potential allergens, such as benzoic acid, benzyl acetate, cinnamic alcohol, cinnamic aldehyde, cinnamic acid, methylcinnamate, eugenol, vanillin, and coniferyl alcohols. Therefore, patients sensitive to balsam of Peru should also avoid these agents topically and should consider their ingestion with caution. Interestingly, flares of dermatitis in patients sensitive to balsam of Peru have been caused by the ingestion of spices and foods containing some of the above ingredients. Two children were reported by Hjorth (5) who were sensitive to balsam of Peru and flared after eating oranges and orange-flavored ice cream. Several other case reports have confirmed this reaction with chocolate, Coca-Cola, cinnamon, and vermouth (5–8) ingestion by patients sensitive to balsam of Peru.

Botanicals

Little has been written about botanicals and ACD. However, with the current popularity of botanical agents being used in personal-care products, more reports will surely be seen. Aloe is commonly used in botanicals, and contact dermatitis has been reported. Arnica flowers have been used for hundreds of years for sprains, bruises, wounds, and other injuries, and they are currently used in cosmetics. Two cases of bullous contact dermatitis to *Arnica montana* tincture, which is used for knee injury, have been reported (9). *Centella asiatica* (i.e., Asiatic pennywort) has been purported to stimulate collagen production by fibroblasts, and therefore, is used on scars with numerous cases of contact allergy reported (9). Lavender oil, used for perfume properties, has been reported to cause contact dermatitis (10). Peppermint is well known to cause ACD, stomatitis, and burning mouth syndrome (9,10). Numerous reports of ACD have been described to tea tree oil, a compound widely used in cosmetics and topically for a variety of cutaneous maladies (10). Cucumber, rosemary, sage, stinging nettle tea and chamomile tea, and witch hazel have all had a few scattered reports of contact dermatitis and positive patch-test reactions (9–11).

Patients should be patch tested to a standard series of patch tests that optimally includes fragrance and botanical screening antigens. For example, the Mayo Standard Series includes not only the standard fragrance mix (see the section on "Fragrances") but also a natural fragrance mix (i.e., jasmine absolute, ylang-ylang, narcissus absolute, sandalwood oil, and spearmint oil). If the clinician has a high index of suspicion that cosmetics are causing the eczema, an expanded natural fragrance series should be considered. Examples of these antigens include chamomile, orange oil, almond oil, lavender oil, and tea tree oil. Also, patch testing the patient's own products can prove essential, since it is not possible to patch test all fragrances and botanicals. Although controversial, if the patient is allergic to a botanical ingredient, optimally, they should avoid all fragrance and botanical ingredients, particularly those botanicals that "sound" fragrance-like, such as orange oil.

Sunscreens

Several sunscreen agents on the market are capable of producing ACD. In the past, para-aminobenzoic acid (PABA), an ultraviolet (UV) B blocker, was the most common sensitizer, with 1.2% of patients having a positive photopatch test reaction, and 3.2% having a routine (nonilluminated) patch test reaction in the NACDG series (1). As a result, PABA is currently used in few sunscreen products. Today, oxybenzone, also known as benzophenone-3, is the most commonly reported sunscreen sensitizer with 0.6% of NACDG patients reacting (1). Avobenzone (Parsol 1789), which blocks UVA, is a less frequent cause of allergic reactions. Derivatives of PABA, benzophenones, cinnamates, and dibenzoylmethanes can all cause photo-allergic dermatitis. Although sunscreen chemicals are a cause of ACD, the fragrances and preservatives found in these sunscreen products are actually the more common cause of sunscreen allergy (12).

Hair-care product allergens

The active ingredients in hair-care products, including hair colorants and permanent waves, are the third most common source of allergic reactions to cosmetic products (1). Only fragrances and preservatives are more common causes of cosmetic induced allergy. The most common cause of allergic reactions to hair-care products is the chemical in permanent hair colorant, para-phenylenediamine (PPD). Para-phenylenediamine is the third most common cosmetic allergen according to the NACDG, demonstrating a positivity rate of 4.9% (1). Para-phenylenediamine usually causes an acute ACD in sensitive individuals. The pattern of involvement characteristically includes the scalp, hairline, face, and eyelids. FIG. 2 shows an example of acute dermatitis with fissuring and erythema of the post-auricular scalp after dying the hair. A more widespread reaction may evolve. Hairdressers who become sensitive to PPD typically develop hand dermatitis that may spread to the arms. Once the hair colorant is fully developed (oxidized), PPD is no longer a potent allergen. Therefore, patients react for several weeks after having their hair colored but will recover without needing to cut the colored hair. Likewise, hairdressers typically do not need to avoid cutting and styling hair that has been previously dyed (13). Henna-based dyes and semipermanent dyes are alternatives for patients sensitive to PPD.

FIG. 2. Poorly marginated erythema with scaling and fissuring in a patient with positive patch test to para-phenylenediamine and a history of using hair coloring.

Allergic reactions to the active agents used in permanent waves are also an important cause of hair-care product dermatitis. Glyceryl thioglycolate is found in acid (heat) permanent waves used exclusively by salons and caused allergic reaction in 2.0% of NACDG patch test patients (1). Ammonium thioglycolate is the chemical in alkaline permanent wave products used both in salons and

marketed for home use. Ammonium thioglycolate is likely to cause an irritant dermatitis and therefore is difficult to use for patch testing. These allergens in permanent waves are rather "permanent" and can continue to cause dermatitis for up to three months in sensitive clients or hair-care workers. Patients who react to glyceryl thioglycolate permanent solutions can typical tolerate ammonium-thioglycolate-based perms and vice versa. There are also cysteine-based perms, which can be used as an alternative if a patient is sensitive to both traditional permanent solutions.

Nail polish and artificial nails

Most allergic reactions to nail polish are caused by tooylamide formaldehyde resin (toluene sulfonamide formaldehyde resin) with a positivity rate of 1.3% in the NACDG series (1). There are alternative nail polishes for the sensitive consumer, which contain polyester resin. Other allergens, which may be present in nail lacquer, include acrylates, fragrance, and sunscreens. Reactions to nail polish are frequently manifested by eyelid involvement. The neck and face are involved in a similar manner. Interestingly, less common areas of involvement include the lateral nail folds (showing erythema and scale) and subungual skin (hyperkeratosis), as demonstrated by the patient in FIG. 3.

Artificial nail products contain various methacrylates (14). Methyl methacrylate is the most common sensitizer of the group, with a positive patch-test rate of 1.1% (1), but all nail acrylates can cause dermatitis. Nail glues, used as adhesive for artificial "press-on" nails, are usually cyanoacrylates and cause contact allergy relatively rarely (1). Patients sensitive to the acrylates of artificial nails usually cannot wear any kind of artificial nail because many of the acrylates cross-react.

A common question asked by patients sensitive to acrylates is whether or not they can wear nail polish. Because many nail polishes contain acrylates or ingredients similar to acrylates, the acrylate sensitive patient should be counseled to avoid nail polish that contains these ingredients.

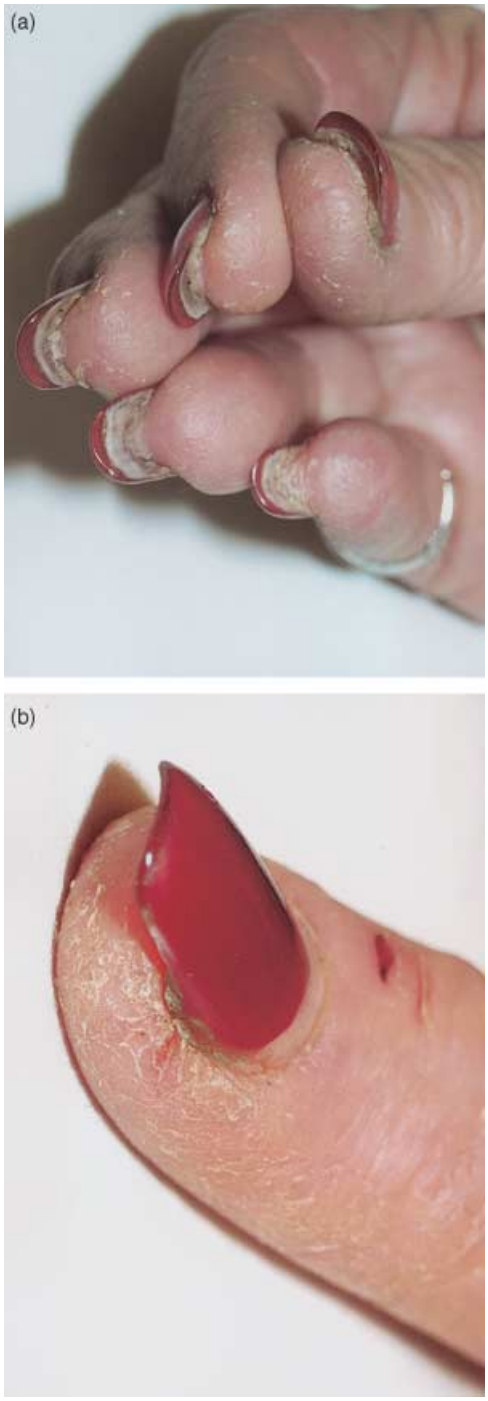

FIG. 3. Subungual hyperkeratosis, scaling, and erythema of the fingertips from chronic dermatitis caused by acrylate allergy in artificial nail-tip glues and nail polish: (a) all the fingertips on one hand; and (b) a close-up of a single finger.

Lanolin

Lanolin is a substance derived from the fleece of sheep, and it is used as a moisturizing agent. The NACDG found that 2.4% of their patients were allergic to lanolin alcohol (1). Lanolin alcohol is thought to be the primary sensitizer, but since lanolin is a natural product derived from sheep, it is composed of hundreds of different chemicals, making it difficult to identify the relevant contact allergens. Lanolin-sensitive patients may tolerate one lanolin product and not another, reflecting its wide variety. If sensitivity is suspected,

patch testing should be performed with the patient's own product to help avoid this problem. Another confounding variable in lanolin allergy is that reactions to lanolin occur on compromised skin more frequently, which is similar to paraben sensitivity (1). This paradoxical reaction may also lead to a false-negative patch-test reaction.

Summary

Allergic contact dermatitis can be caused by a variety of chemicals in cosmetics, including fragrances, botanicals and preservatives. Since personal-care products are widely used, dermatologists can expect to see patients in consultation for ACD related to these products. Patch testing is necessary to detect the exact causes of ACD, allowing patients to avoid their allergens. The CARD is a computerized database containing thousands of cosmetics and personal-care products that can be helpful in guiding the patient with ACD and known allergens away from those products containing their allergen. It is available online through the American Contact Dermatitis Society website (www.contactderm.org). The clinician inputs the patient's allergens, and a listing of products the patient *can* use will be generated. Patients find CARD a helpful tool because they often feel overwhelmed when told what products they *cannot* use, or when they are asked to avoid allergens with long and complex names by reading product ingredient labels.

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