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Allergic Contact Dermatitis to Preservatives and Fragrances in Cosmetics

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ABSTRACT

Cosmetics are an important cause of allergic contact dermatitis (ACD). Fragrances and preservatives are the two most clinically relevant allergens found in cosmetic products. Patch testing remains the gold standard for identification of causative allergens. Common cosmetic allergens are reviewed. Practical methods of allergen avoidance are also discussed.

Key Words: *allergic contact dermatitis, fragrance, preservative, skin care*

Introduction

The term "cosmetic" is used synonymously with "make-up" in the general population. However, it has a much broader definition and includes personal care products, hair care, nail products, and sunscreens.

There is an impressive array of cosmetic products available on the market today, with an even greater number of individual ingredients. The number of new products continues to increase and the rates of adverse cutaneous reactions are expected to rise. Therefore, given the widespread use of cosmetics, it is important to monitor their side-effects. It is estimated that the average woman uses 12 personal care products daily, which comprise 168 unique ingredients. The average man uses six personal care products each day with 85 unique ingredients.¹ Skin care products have been found to account for the majority of cases of allergic contact dermatitis (ACD) to cosmetics, followed by hair care and nail cosmetics.²⁻⁵ The most common responsible cosmetic allergens are fragrances and preservatives.⁶

Epidemiology

The prevalence of cosmetic allergy is estimated at less than 1% in the general population.⁷⁻⁹ However, since most people do not seek medical consultation for mild adverse reactions, the actual rates are likely much higher. Pooled data of seven different studies involving 30,207 patients patch tested for suspected contact dermatitis revealed that 9.8% of positive reactions were due to cosmetic allergens.¹⁰ A recent Danish study showed that the prevalence of ACD to cosmetic allergens has doubled between 1990 and 1998.¹¹ The majority of patients affected with ACD to cosmetic products are women between the ages of 20 and 55.^{2,7-9}

In addition, a study of 794 patients showed that 34% of patients would have been missed if they were only tested with NACDG (North American Contact Dermatitis Group) screening series of 65 allergens.¹² A European analysis of 5911 cosmetic-allergic patients found that one-third reacted only to a personal product and no other allergen.¹³ Thus, while the optimal number of allergens for patch testing to cosmetics is not firmly established, testing for additional allergens using a specialized cosmetic series and the patient's own personal products would capture about 30% of additional patients that otherwise would have been missed.

Clinical Features of ACD

ACD may have acute and chronic forms. Acutely, it presents with pruritic papules, vesicles, and bullae. Chronic forms are more common and present with pruritic, scaly papules and plaques distributed in areas of most contact with the offending allergen. The distribution provides very useful clinical clues about the possible causative agent. Occasionally, ACD may produce autoeczematization resulting in a widespread or generalized cutaneous eruption. Allergens may also be transferred from other persons or even pets, resulting in "connubial" or "consort" dermatitis.¹⁴⁻¹⁶

The main differential diagnostic possibilities for ACD are exacerbation of atopic dermatitis or irritant contact dermatitis, both of which are far more common than allergic contact reactions.

Classes of Allergens Responsible for ACD

Cosmetic ingredients can be classified into several categories: fragrances, preservatives, antioxidants, vehicles, ultraviolet absorbers, humectants, emollients, emulsifiers, acrylates, hair dyes, nail polish components, and others.

Preservatives and fragrances are the most frequently detected culprits; therefore, this review will primarily deal with these two classes of allergens.

Preservatives

Preservatives were identified as the most common cosmetic contact allergens in several recent studies.^{6,17,18} They can be classified into three broad categories: antimicrobials, antioxidants, and ultraviolet light absorbers. The antimicrobial agents can be further divided into formaldehyde preservatives, formaldehyde-releasers, and non-formaldehyde-releasing preservatives. Formaldehyde-releasing preservatives (FRP) include quaternium-15, diazolidinyl urea, imidazolidinyl urea, 2-bromo-2-nitropropane-1,3-diol, and DMDM hydantoin. Non-formaldehyde-releasing preservatives include parabens, methylchloroisothiazolinone-methylisothiazolinone (MCI-MI), methylidibromoglutaronitrile-phenoxyethanol (MDBGN-PE), and iodopropynyl butylcarbamate. Individuals allergic to formaldehyde may also be allergic to any of the FRPs.

Formaldehyde-sensitized individuals may experience a flare of ACD with a number of foods, including cod fish, caviar, coffee, shiitake mushrooms, smoked ham, maple syrup, and aspartame.¹⁹ Table 1 lists the top 20 NACDG screening allergens associated with cosmetic source in females.¹⁷

For comparison, Tables 2a and 2b list the top 10 allergens from the North American Contact Dermatitis Group (NACDG) and the Mayo Clinic Contact Dermatitis Group (MCCDG) identified in all patients presenting for patch testing. It is evident that many of the top allergens are from cosmetic sources.

Fragrances

There are over 3000 different fragrances used in cosmetics today.²⁰ Not surprisingly, fragrances represent the second most common group of cosmetic allergens. Available tools to assess for fragrance allergy are fragrance mix I (FMI), fragrance mix II (FMII), and balsam of Peru. The components of these screening allergens are listed below:

1	Quaternium-15 2%	323	20.4	11.1
2/3	Myroxylon pereirae (balsam of Peru) 25%	302	19.1	10.3
2/3	Fragrance mix 8%	302	19.1	10.3
4	p-Phenylenediamine 1%	247	15.6	8.5
5	Methyldibromoglutaronitrile/phenoxyethanol 2%	131	8.3	4.5
6	Formaldehyde 1%	108	6.8	3.7
7	Tosylamide formaldehyde resin 10%	97	6.1	3.3
8	Cocamidopropyl betaine 1%	84	5.3	2.9
9	Glyceryl thioglycolate 1%	83	5.3	2.8
10/11	Diazolidinyl urea 1%	79	5.0	2.7
10/11	Diazolidinyl urea 1%	79	5.0	2.7
12	DMDM hydantoin 1%	77	4.9	2.6
13	Lanolin alcohol 30%	71	4.5	2.4
14/15	Imidazolidinyl urea 2%	70	4.4	2.4
14/15	Methylchloroisothiazolinone/methylisothiazolinone 100 ppm *	70	4.4	2.4
16	Methyl methacrylate 2%	65	4.1	2.2
17	Amidoamine 0.1%	63	4.0	2.2
18	Propylene glycol 30%	61	3.9	2.1
19	DMDM hydantoin 1%	58	3.7	2.0
19	Imidazolidinyl urea 2%	51	3.2	1.8

Table 1: Top 20 NACDG screening allergens associated with cosmetics in females

* Not in petrolatum; all others are

Fragrance Mix I (8.0 % in petrolatum)

- Amyl cinnamic alcohol 1.0%
- Cinnamic alcohol 1.0%
- Eugenol 1.0%
- Cinnamic aldehyde 1.0%
- Hydroxycitronellal 1.0%
- Geraniol 1.0%
- Isoeugenol 1.0%
- Oak moss absolute 1.0%
- Sorbitan sesquileate (emulsifier) 5.0%

Fragrance Mix II (14.0 % in petrolatum)

- Hydroxyisohexyl 3-cyclohexene carboxaldehyde (2.5%)
- Citral 1.0%
- Farnesol 2.5%
- Coumarin 2.5%
- Citronellol 0.5%
- Hexyl cinnamal 5.0%

Many of the specific fragrance ingredients are protected by the Fair Packaging and Labeling Act as they are considered trade secrets.¹⁹ It is important to keep in mind that many products labeled as 'unscented', 'hypoallergenic', or even 'fragrance-free' do, in fact, contain masking fragrances.

10 Most Common Allergens NACDG

Nickel sulfate

Neomycin

10 Most Common Allergens MCCDG

Nickel sulfate

Balsam of Peru

Cross Reacting Agents

Balsam of Tolu

Benzoin

Balsam of Peru	Gold sodium thiosulfate	Benzyl acetate
Fragrance mix	Neomycin	Benzyl alcohol
Thimerosal	Fragrance mix	Cinnamic alcohol/cinnamic aldehyde
Gold sodium thiosulfate	Thimerosal	Cinnamon oil
Quaternium-15	Cobalt chloride	Clove oil
Formaldehyde	Formaldehyde	Essential oils of orange peel
Bacitracin	Benzalkonium chloride	Eugenol
Cobalt chloride	Bacitracin	Propolis

Table 2a: Top 10 list of common contact allergens from NACDG

Table 2b: Top 10 list of common contact allergens from MCCDG

Table 3: Cross-reactants with balsam of Peru

Balsam of Peru

Balsam of Peru (BOP) (myroxylon pereirae resin) is an aromatic fluid that comes from the bark of the tree Myroxylon balsamum, a tree native to El Salvador.¹⁹ It is a complex mixture of many ingredients, all of which have not yet been completely identified. Key ingredients including benzoyl cinnamate, benzoyl benzoate, benzoic acid, vanillin, and nerodilol can be found in the following three groups of products: fragrance in perfumes and toiletries, flavorings in foods and drinks, and medicaments. In the past, FMI and BOP were able to detect approximately 90% of fragrance allergies. However, with the increasing number of fragrances and botanicals in use today, their screening ability is now estimated to be around 60%.¹⁹ Thus, FMI and a number of botanical extracts are now part of the 2010 NACDG screening series that comprise 70 allergens. Often, additional cosmetic and botanical series are required to diagnose fragrance allergy. Patients with contact allergy to BOP may also react to a number of substances that are well known cross-reactants with BOP (Table 3). Thus, patients should be appropriately counseled to avoid these agents.

Practical Considerations and Clinical Pearls

- Choose allergens carefully: based on history, occupation, hobbies, and distribution of dermatitis. Patch testing may need to be expanded beyond the NACDG screening series to include, for example, a cosmetic/botanical supplemental series. This series may be indicated in patients using a variety of make-up products or for those who use 'all natural' botanical products. Testing to personal care products may lead to identification of additional relevant allergens, as well as facilitate discovery of new and emerging allergens, as new compounds are being introduced at an escalating pace.
- Have a good working knowledge of common allergens and their sources: this is critical for choosing the correct allergens to test as well as for counseling patients on allergen avoidance.
- Have access to available resources: an excellent review of the main concepts of ACD is found in Contact Allergy: Alternatives for the 2007 NACDG Standard Screening Tray.¹⁹ Allergen information sheets are available to the members of the American Contact Dermatitis Society (ACDS) and can be found at www.contactderm.org. Identification of allergen-free products can be accomplished by generating a customized product list with the use of the Contact Allergen Management Program (CAMP) available to the members of the ACDS. Multiple allergens can be entered to generate a 'shopping list' of products that are safe to use in a patient with allergic contact dermatitis to their cosmetics.

Conclusion

Allergic contact dermatitis to cosmetics is an important cause of ACD overall. The main causes of cosmetic allergy are fragrances and preservatives. It is rewarding for both the patient and the physician if the responsible agent can be identified and subsequently removed from the patient's environment. Patient satisfaction and compliance will also improve if meaningful counseling is provided, including detailed information on safe to use personal care products.

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