

Contact Urticaria to Cosmetic and Toiletry Ingredients

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The use of cosmetics and toiletries is a practice that extends worldwide and reaches virtually everyone. Even though most cosmetics and toiletries are safe for most consumers, a significant minority of people experience adverse reactions, including contact urticaria, an immediate-type hypersensitivity skin reaction from exposure to a triggering ingredient. This article reviews the pathophysiology and different clinical manifestations of contact urticaria and its association with cosmetics and toiletries.

The term *contact dermatitis* refers to a group of dermatoses that result from exposing the skin to a triggering chemical. For practical reasons, there are 3 main clinical forms: irritant contact dermatitis (ICD), allergic contact dermatitis (ACD), and contact urticaria (CU).

ICD, the most common clinical form of contact dermatitis (≈80% of cases), represents a nonspecific inflammatory response to a chemical when the skin barrier function is impaired. This is a nonimmunologic reaction that may occur in anyone whose skin is chemically damaged. Although most cosmetics and toiletries are formulated to be nonirritating, the potential for irritation exists, especially in persons with sensitive skin. On the other hand, ACD denotes an immunologic reaction with lymphocyte activation described as a type 4, T-cell-mediated, delayed-type hypersensitivity reaction. In addition to the delayed reactions of ACD, immediate-type hypersensitivity reactions (ie, CU) may occur. These account for approximately 0.5% of contact dermatitis cases; however, they are important because repeated exposure to a causative agent may be followed by eczematous changes of the skin. In these cases, the eczematous response may mask the urticarial component of the disease.¹

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CONTACT REACTIONS TO COSMETICS AND TOILETRIES

Cosmetics and toiletries have been used for centuries. Virtually everyone uses some form of cosmetics and toiletries, such as hair care products, skin moisturizers, facial cosmetics, facial cleansers, deodorants, and fragrances.² It has been estimated that approximately 8000 raw material, vehicle, and fragrance ingredients are used in making cosmetics and toiletries,³ and although most cosmetics and toiletries are safe for most users, a significant minority of people experience adverse reactions, including CU.⁴

The exact frequency of adverse reactions to cosmetics and toiletries in the general population is difficult to estimate,⁵ mainly because most people who experience such reactions seldom consult a physician and discontinue using the products suspected of triggering the reaction.⁶ Even less is known of the accurate, detailed incidence and prevalence of CU to cosmetics and toiletries. For example, in patients who are patch tested for suspected ACD, previous studies have shown a fluctuating 4% prevalence rate of delayed allergic reactions.⁷⁻⁹ However, very few studies have looked at the frequency of CU to cosmetic and toiletry ingredients. In 1985, Emmons and Marks¹⁰ studied a group of 50 individuals consisting of 19 controls, 15 patients with eczematous dermatitis (nonspecific, chronic, idiopathic eruption), and 16 patients with sensitivity to cosmetic or toiletry ingredients (a history of adverse reactions to a cosmetic or toiletry product or a dermatitis in a distribution believed to be caused by a cosmetic or toiletry product). Interestingly, 47 of the 50 volunteers had at least one positive nonimmunologic

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CU reaction after open testing. This underscores the possibility of a significant unreported prevalence of CU to cosmetics and toiletries.

DEFINITION AND CLASSIFICATION OF CU

CU refers to a wheal-and-erythema reaction elicited by exposure of the skin to a triggering external substance. For example, CU to bee stings, peanuts, and natural latex are undoubtedly the most typical and illustrative examples of immediate-type immunologic reactions. First defined in 1975 by Maibach and Johnson,¹¹ the term *contact urticaria syndrome* comprises a heterogeneous group of inflammatory skin reactions that usually appear within 15 to 60 minutes after contact with the triggering substance. Typically, symptoms disappear within a few hours (by definition, within 24 hours of onset).

CU may be classified as nonimmunologic (NICU) or immunologic (ICU) according to the underlying pathophysiologic mechanism.¹² A third category exists for reactions with mixed features or undetermined pathophysiology and is described as CU of uncertain origin.^{13,14}

NONIMMUNOLOGIC CONTACT URTICARIA

NICU may also be called *immediate-type irritancy*. Typically, NICU occurs without previous sensitization to a chemical in the exposed individual, and it is the most common immediate-type contact reaction.¹⁵ However, the epidemiology of NICU is poorly documented, partly because contact urticaria is easily recognizable when wheals are present but there is confusion about what constitutes a milder reaction. Kligman,¹⁶ for example, demonstrated that by diluting classic urticariogenic agents, the immediate-type reaction may be limited to erythema or pruritus alone; therefore, he argued that NICU is more common than is believed and that it is unrecognized because of so-called suburticariogenic forms. However, not all substances causing immediate-type erythema are urticants; therefore, immediate-type erythematous reactions are included under a broader category known as nonimmunologic immediate-contact reactions (NIICRs).¹⁷ Symptoms of NIICRs are heterogeneous and include sensory symptoms, such as burning, tingling, stinging, and pruritus.

The intensity of an NIICR varies depending on the concentration and vehicle of the triggering substance, as well as the skin area exposed and the mode of exposure (ie, continuous exposure versus occasional exposure).¹⁸ Burning, tingling, or pruritus, accompanied by erythema, is the weakest type of reaction and is usually caused by cosmetics or toiletries.¹⁰ A local wheal-and-erythema reaction constitutes the prototype reaction of CU. Generalized

urticaria after local contact is rare, but has been anecdotally reported. Interestingly, repeated applications of NICU-causing agents may cause eczematous-type reactions.¹²

The mechanisms of NIICRs, as with those of other irritant reactions, are not thoroughly understood. NIICRs were once believed to be from nonspecific histamine release from mast cells. However, it has been shown that H₁ antihistamines do not inhibit reactions to well-known urticants such as benzoic and cinnamic acids, cinnamic aldehyde, methyl nicotinate, and dimethyl sulfoxide.^{17,19} These results suggest that histamine is not the main mediator in NIICRs. Similarly, NIICRs may be inhibited by acetylsalicylic acid and indomethacin^{20,21} and by topical applications of diclofenac or naproxen gels.²² The duration of inhibition from a single dose of acetylsalicylic acid may last up to 4 days.²³ The mechanisms by which nonsteroidal anti-inflammatory drugs inhibit NIICRs have not been established; however, they are probably due to inhibition of prostaglandins.

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ICU is the less common reaction, and by definition it is a type 1 hypersensitivity reaction mediated by allergen-specific immunoglobulin E (IgE) antibodies made specifically against the triggering substance. Therefore, prior immune sensitization is required for this type of CU to occur. Interestingly, cross-reactivity may also induce ICU reactions.²⁴ The specific IgE antibodies may be detected in the serum with the use of the radioallergosorbent test. It is generally believed that people with an atopic background (personal or family history of eczema, hay fever, or asthma) are most predisposed to ICU.¹² Sensitization may occur via percutaneous delivery or through the mucous membranes of the respiratory and gastrointestinal tracts.

It is important to note that ICU reactions may spread beyond the site of contact and progress to generalized urticaria. In the most severe scenario, ICU may involve other organs and finally lead to anaphylactic shock. This potential for multisystem involvement was first highlighted by Maibach and Johnson,¹¹ and later, Amin et al¹² developed the contact urticaria syndrome staging system, which organizes the different possible symptoms into 4 stages (Table 1).

The mechanisms following skin exposure to allergens involve allergen penetration through the epidermis, which then reacts with specific IgE molecules attached to mast-cell membranes, causing degranulation and release of histamine and other vasoactive substances. The role of histamine is important, but other mediators of inflammation, such as prostaglandins, leukotrienes, and kinins, may also influence the intensity of response. It is important to mention that immediate- and delayed-type contact allergy (ACD) to the same substance may coexist.²⁵

TABLE 1

Contact Urticaria Syndrome Staging System¹²

Cutaneous Reactions	
Stage 1	Localized urticaria (redness and swelling); dermatitis (eczema); nonspecific sensory symptoms (burning, tingling, stinging, pruritus)
Stage 2	Generalized urticaria
Extracutaneous Reactions	
Stage 3	Bronchospasm; rhinitis; conjunctivitis; orolaryngeal symptoms (lip swelling, hoarseness, difficulty swallowing); gastrointestinal symptoms (nausea, vomiting, diarrhea, abdominal pain)
Stage 4	Anaphylactic shock

DIAGNOSIS

Diagnosis of CU is based on both skin testing and a detailed history.²⁶ However, given the possibility of extracutaneous reactions, including anaphylaxis, the diagnosis of ICU may also be done in vitro using the radioallergosorbent test, which detects antigen-specific IgE molecules in the serum. There are several in vivo skin tests for both NICU and ICU: the open test, the skin prick test, the scratch test, the scratch-chamber test, and the use test.

When testing for ICU in vivo in patients with a history of extracutaneous involvement, dilute allergen concentrations and serial dilutions are required to avoid reproducing systemic reactions. Testing should be conducted under carefully controlled conditions (ie, resuscitation equipment and personnel trained to provide resuscitation should be immediately available)^{12,27} because anaphylaxis secondary to contact with topically applied chemicals is possible, although uncommon, in some sensitized patients. Furthermore, in any of the skin tests, it is important to perform positive (histamine, 1 mg/mL) and negative (normal saline) controls²⁶ to avoid misinterpreting false-positive and false-negative reactions.

Open Test

In the open test, 0.1 mL of the test substance in a vehicle of petrolatum, alcohol, or water is spread over a 3×3-cm area at the desired site. Generally, alcohol vehicles are recommended because they have been shown to enhance test sensitivity compared with petrolatum or water vehicles.²⁶ The open test should be performed on an approximately 1-cm area of healthy, nondiseased skin; if negative, the open test should then be performed on previously or currently affected skin. The reason is that there is a significant difference among skin sites in their ability to elicit CU, especially in cases of NICU but

also in ICU.^{28,29} Test sites are usually read at 20, 40, and 60 minutes. ICU reactions typically appear within 15 to 20 minutes; NICU reactions may be delayed up to 45 to 60 minutes following application.¹²

When testing more complex formulations found in leave-on (versus rinse-off) products, such as foundations, lip balms, moisturizers, or sunblocks, adding a vehicle is unnecessary, and patients will be able to perform the test on themselves using the product as is. Patients may be advised to test new leave-on products by applying a small (half- or whole-pea-sized) quantity on the inner upper arm and to wait 15 to 60 minutes for any signs of reaction (eg, burning, tingling, stinging, pruritus, erythema, or wheals at the application site or a distant site). If a reaction occurs, patients should be advised to note the product name and ingredients in a diary. Doing so may help direct testing or, should an identifiable pattern appear (eg, from using a specific chemical in multiple formulations), may help determine the culprit.

Skin Prick Test

The skin prick test is often the test of choice should the open test be negative.²⁶ The technique is to apply the allergen in a vehicle to the volar aspect of the patient's forearm and then pierce the site with a lancet to introduce the allergen into the skin. The site is usually read within 30 minutes. Prick testing theoretically carries a low risk of anaphylaxis because only small amounts of the allergen are introduced into the skin.

One use of the skin prick test is to assess sensitization to oatmeal protein.³⁰ An ingredient commonly used in colloidal preparations, emollients, and moisturizers, oatmeal protein has been identified anecdotally as a causative agent of ICU.³¹ Table 2 indicates other causative agents of ICU.

TABLE 2

Cosmetic and Toiletry Ingredients Reported to Cause Contact Urticaria

Substance	NICU	ICU	CU of Uncertain Origin	Possible Sources
Acetic acid ^{32,33}	Yes	No	No	Nail-improving treatments; hydrocortisone cream; hair-styling gels; facial cleansers; hair-coloring products; sunless tanning lotions; shampoo and conditioners; shaving creams; aftershave; exfoliants
Acrylic monomer ^{32,33}	No	Yes	No	Hair spray; hair-styling gels/mousse; nail polish; mascara; lip gloss; lipstick; foundation; concealers; eyeliner; eye shadow; moisturizers; depilatory creams; hair-coloring products
Ammonia	No	Yes	No	Hair-coloring and hair-bleaching products
Ammonium persulfate ^{32,33}	Yes	No	Yes	Hair-coloring and hair-bleaching products
Balsam of Peru ³²⁻³⁵	Yes	Yes	No	Diaper creams; moisturizers; shampoo and conditioners; hydrocortisone creams; toothpaste; mouthwash
Basic Blue 99 ^{32,33}	No	Yes	No	Shampoo; hair-coloring products
Benzoic acid ³²⁻³⁴	Yes	Yes	No	Mouthwash; body washes; moisturizers; shampoo; sunblocks; facial cleansers; foundation; exfoliants
Benzophenone	Yes	Yes ³⁶	No	Sunblocks; moisturizers; lip balm; lipstick; conditioners; men's and women's fragrances; foundation
Benzoyl peroxide ³⁷	No	Yes	No	Topical acne treatments
Benzyl alcohol ^{32,33}	No	Yes	No	Shampoo and conditioners; moisturizers; sunblocks; facial cleansers; women's fragrances
Chamomile ³⁸	No	Yes	No	Facial cleansers; moisturizers; concealers; topical acne treatments; body washes; conditioners; hair-coloring and hair-bleaching products
Chlorhexidine ³⁹	No	Yes	No	Moisturizers; conditioners; facial cleansers
Chlorocresol	Yes ⁴⁰	No	Yes ⁴¹	Topical antifungal treatments; foot-odor-control products
Cetyl alcohol ¹²	Yes	Yes	No	Moisturizers; shampoo and conditioners; hair-coloring products; sunblocks; facial cleansers; exfoliants
Cinnamic alcohol ⁴²	Yes	No	No	Men's and women's fragrances; moisturizers; hair-coloring products; body powders; deodorants; bath oils; liquid hand soaps; aftershave; exfoliants
Cinnamic aldehyde ^{34,43}	Yes	No	No	Men's and women's fragrances; moisturizers; body washes; bubble bath; liquid hand soaps; bar soaps; bath and body oils; lip liner
Collagen ⁴⁴	Yes	Yes	No	
Hydrolyzed collagen				Shampoo and conditioners; hair relaxers; hair-styling gels; moisturizers; sunblocks; sunless tanning lotions; body washes
Hydroxypropyl trimonium				Nail treatment; conditioners

TABLE 2 (continued)

Cosmetic and Toiletry Ingredients Reported to Cause Contact Urticaria

Substance	NICU	ICU	CU of Uncertain Origin	Possible Sources
Copper ⁴⁵	No	Yes	No	Moisturizers; antiaging creams; sunblocks; toners; astringents; exfoliants
Coumarin ⁴²	Yes	No	No	Men's and women's fragrances; moisturizers; hand creams; sunless tanning lotions; body oils; body washes; exfoliants
Diethyl toluamide	No	Yes	No	Insect repellants
Eugenol ⁴²	Yes	No	No	Men's and women's fragrances; moisturizers; facial cleansers; exfoliants; body washes; sunblocks
Formaldehyde ^{34,46}	Yes	Yes	No	Hair-coloring products; nail treatment; nail polish; hair-styling gels; mascara
Formaldehyde releasers ¹²	Yes	No	No	Shampoo and conditioners; facial cleansers; baby powder; body washes; baby soaps; sunblocks; moisturizers; mascara
Fragrance mix ⁴⁷	Yes	Yes	No	Shampoo and conditioners; moisturizers; body washes; facial cleansers; soaps; hair-styling gels/mousse; hair spray; sunblocks; sunless tanning lotions; deodorants; men's and women's fragrances; facial cosmetics
Geraniol ⁴⁸	No	Yes	No	Men's and women's fragrances; moisturizers; body washes; body oils; sunless tanning lotions; exfoliants; bubble bath
Henna ^{32,33}	No	Yes	No	Temporary tattoos; shampoo and conditioners; hair spray; hair-styling gels/lotions; sunless tanning lotions; hair relaxers; hair-coloring products; depilatory creams
Hydroxycitronella ⁴²	Yes	No	No	Insect repellents; sunblocks; facial cleansers; moisturizers; shampoo and conditioners; body washes
Lanolin ^{32,33}	No	Yes	No	Lipstick; lip balm; lip gloss; conditioners; foundation; moisturizer
Menthol ^{32,33}	No	Yes	No	Topical pain-relief treatments; facial cleansers; topical acne treatments; lip balm; lip gloss; hydrocortisone creams; mouthwash; toothpaste; foot-odor-control products; shampoo
Methylchloro-isothiazolinone/ methylothiazolinone ⁴⁹	Yes	No	No	Shampoo and conditioners; body washes; facial cleansers; hair-styling gels; bubble bath; moisturizers; hair relaxers; hair-coloring products
Milk protein ⁴⁴ (hydroxypropyltrimonium hydrolyzed)	No	Yes	No	Shampoo and conditioners; hair relaxers; body washes; facial cleansers; liquid hand soaps; moisturizers; shaving creams
Oatmeal ³¹	No	Yes	No	Emollients; moisturizers
Panthenol ⁵⁰	No	Yes	No	Moisturizers; shampoo and conditioners; hair-coloring products; hair-styling gels; facial cleansers; hair spray; sunblocks

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TABLE 2 (continued)

Cosmetic and Toiletry Ingredients Reported to Cause Contact Urticaria

Substance	NICU	ICU	CU of Uncertain Origin	Possible Sources
Parabens ⁵¹	No	Yes	No	Moisturizers; facial cleansers; sunblocks; shampoo and conditioners; hair-coloring products; facial cosmetics; foundation; lipstick; lip gloss; body washes
Paraphenylenediamine ^{32,33,52,53}	No	Yes	Yes	Hair-coloring products
Polyethylene glycol ³²	No	Yes	No	Facial cleansers; moisturizers; toothpaste; topical antifungal treatments; topical pain-relief treatment; lubricants; spermicide
Polysorbate 60 ³²	No	Yes	No	Moisturizers; conditioners; facial cleansers; sunblocks; exfoliants; sunless tanning lotions
Salicylic acid	No	Yes	No	Topical acne treatments; facial cleansers; moisturizers; exfoliants; shampoo; toners; astringents; foundation
Sodium benzoate ^{32,33}	Yes	No	No	Shampoo and conditioners; body washes; mouthwashes; moisturizers; toothpaste; facial cleansers; hair spray; lubricants; spermicide
Sodium sulfide ^{32,33}	No	Yes	No	Bar soaps; body washes; topical pain-relief treatments
Sorbic acid ³²⁻³⁴	Yes	No	No	Moisturizers; mascara; lipstick; blush; eye shadow; facial cleansers; exfoliants
Sorbitan monolaurate ^{32,33}	No	Yes	No	Foundation; mascara; moisturizers; sunblocks; facial cleansers; shampoo; concealers
Sorbitan sesquioleate ⁵⁴	No	Yes	No	Mascara; foundation; concealers; moisturizers; lipstick; sunblocks; eyeliner; diaper creams
Stearyl alcohol ¹²	Yes	Yes	No	Conditioners; moisturizers; deodorants; sunblocks; facial cleansers
Tocopherol (vitamin E)	No	Yes	No	Moisturizers; lipstick; lip gloss; lip balm; sunblocks; foundation
Vanillin ^{32,33}	Yes	No	No	Lipstick; lip balm; lip gloss; moisturizers; body washes; shampoo

Abbreviations: CU, contact urticaria; ICU, immunologic contact urticaria; NICU, nonimmunologic contact urticaria.

Scratch Test

The first skin test, performed by Blackley⁵⁵ in 1873, was the scratch test. Blackley abraded an approximately 1-cm² area of skin. Later, investigators developed the scarifier to scratch the skin without causing bleeding. A drop of test solution was then applied to the scratched skin.⁵⁶ False-positive reactions are more easily elicited by the scratch test than by the skin prick test,⁵⁷ primarily because the trauma of the scratch may result in large, nonspecific reactions induced even with

negative-control solutions.⁵⁶ This fact makes defining the cutoff limit between negative and positive tests difficult, rendering the scratch test a less standardized method. The test is therefore reserved for analyzing allergens awaiting standardization, such as certain plant extracts, fragrances, and foods. An important aspect of the scratch test is the need for group control (≥ 10 people) to avoid a false-positive interpretation of results.²⁶ The test is usually read within 30 minutes.

The scratch test has been used for evaluating the potential of protein hydrolysates (collagen, keratin, elastin, milk, wheat, almond, and silk) to cause immediate-type skin reactions.⁴⁴ Protein hydrolysates are added to many cosmetic and toiletry products, including soaps, creams, hair conditioners, and bath gels (Table 2).

Scratch-Chamber Test

The scratch-chamber test is an occlusive test method. The chemicals are placed in small aluminum or plastic containers and then attached to the previously scratched skin with a porous tape for 15 minutes. Results are read at 20, 40, and 60 minutes. Occlusion enhances percutaneous penetration; therefore, the sensitivity of the test is probably higher than the scratch test alone. Another advantage is that a smaller area of skin is needed compared with the open test. The scratch-chamber test has been used for evaluating immediate-type skin reactions to sunblocks.⁵⁸

Use Test

With the use test, a patient known to be affected by a certain product will use that product the same way as when the symptoms first appeared. The use test is particularly helpful when the triggering ingredients of a bothersome cosmetic or toiletry are not disclosed in the product labeling, as is often the case with fragrances. Fragrances are found in many cosmetics and toiletries and are, in fact, the most common cause of allergy to such products.⁴ It is estimated that more than 3000 synthetic fragrances and hundreds of essential oils are used in modern cosmetics and toiletries.⁵⁹ Even so, manufacturers are required to only use the terms *fragrance* or *perfume* in the ingredients list of product labeling rather than list all the specific fragrance ingredients used.⁴

Considering all the skin test methods, Warner et al³² recommended that suspected agents be tested with an open test on normal skin. If the test results are negative, Warner et al³² advised to conduct an open test application on the previously affected, yet normal-appearing skin. However, if testing on eczematous skin, test on an area showing only slight erythema. If all of the previous tests results are negative, then an occluded patch test should be performed on normal or previously affected skin. If the test results are still negative, skin prick testing should be performed. Scratch and scratch-chamber tests are more likely to produce a false-positive response.³²

It is important to note that with all the skin tests, CU reactions may be graded visually by using an ordinal scale based on the degree of erythema and edema. For example, for erythema, Frosch and Kligman⁶⁰ developed the following scale: 1+=light erythema, spotty or diffuse; 2+=moderate uniform erythema; 3+=intense erythema; and 4+=fiery erythema with edema. Similarly,

Gollhausen and Kligman³⁴ developed the following scale to score edema: 1=slight edema, barely visible or palpable; 2=unmistakable wheal, easily palpable; 3=solid, tense wheal; and 4=tense wheal, extending beyond the test area.

MANAGING CU FROM COSMETICS AND TOILETRIES

Patients need to be well informed of the nature of their urticarial reactions and of avoidance techniques and suitable product alternatives. Once a relevant irritant or allergen has been identified, it should then be avoided by paying careful attention to product labeling or avoiding products with no labeling. However, many ingredients, especially fragrances, are not listed on product labeling. Therefore, for patients with NICU, several trial-and-error courses, although seemingly impractical, may sometimes be necessary.

Patients with ICU may benefit from antihistamine therapy for mild reactions and should be advised to have continuous access to self-administered epinephrine devices to treat potentially life-threatening conditions, such as anaphylactic shock. Patients with ICU should also be advised to purchase medical alert tags specifying their allergens and potential cross-reacting substances.²⁴

REFERENCES

- Liddle M, Hull C, Liu C, et al. Contact urticaria from curcumin. *Dermatitis*. 2006;17:196-197.
- Project Associates Inc. *The Cosmetic Benefit Study*. Washington, DC: Cosmetic, Toiletry & Fragrance Association Inc; 1978.
- Eiermann HJ, Larsen W, Maibach HI, et al. Prospective study of cosmetic reactions: 1977-1980. *J Am Acad Dermatol*. 1982;6:909-917.
- Scheman A. Adverse reactions to cosmetic ingredients. *Dermatol Clin*. 2000;18:685-698.
- de Groot AC. Labelling cosmetics with their ingredients. *BMJ*. 1990;300:1636-1638.
- Mehta SS, Reddy BS. Cosmetic dermatitis—current perspectives. *Int J Dermatol*. 2003;42:533-542.
- Romaguera C, Camarasa JM, Alomar A, et al. Patch tests with allergens related to cosmetics. *Contact Dermatitis*. 1983;9:167-168.
- de Groot AC. Contact allergy to cosmetics: causative ingredients. *Contact Dermatitis*. 1987;17:26-34.
- Adams RM, Maibach HI. A five-year study of cosmetic reactions. *J Am Acad Dermatol*. 1985;13:1062-1069.
- Emmons WW, Marks JG Jr. Immediate and delayed reactions to cosmetic ingredients. *Contact Dermatitis*. 1985;13:258-265.
- Maibach HI, Johnson HL. Contact urticaria syndrome: contact urticaria to diethyltoluamide (immediate-type hypersensitivity). *Arch Dermatol*. 1975;111:726-730.
- Amin S, Maibach HI, Lahti A. *Contact Urticaria Syndrome*. Boca Raton, FL: CRC Press; 1997.
- Wakelin SH. Contact urticaria. *Clin Exp Dermatol*. 2001;26:132-136.
- Cronin E. *Contact Dermatitis*. Edinburgh, Scotland: Churchill Livingstone; 1980.
- Lahti A. Immediate contact reactions. In: Rycroft RJG, Menne T, Frosch PJ, eds. *Textbook of Contact Dermatitis*. Berlin, Germany: Springer-Verlag; 1995.
- Kligman AM. The spectrum of contact urticaria: wheals, erythema, and pruritus. *Dermatol Clin*. 1990;8:57-60.

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17. Lahti A. Immediate contact reactions. *Curr Probl Dermatol*. 1995;22:17-23.
18. Lahti A. Non-immunologic contact urticaria. *Acta Derm Venereol Suppl* (Stockh). 1980;60(suppl 91):1-49.
19. Lahti A. Terfenadine does not inhibit non-immunologic contact urticaria. *Contact Dermatitis*. 1987;16:220-223.
20. Lahti A, Oikarinen A, Viinikka L, et al. Prostaglandins in contact urticaria induced by benzoic acid. *Acta Derm Venereol*. 1983;63:425-427.
21. Lahti A, Väänänen A, Kokkonen EL, et al. Acetylsalicylic acid inhibits non-immunologic contact urticaria. *Contact Dermatitis*. 1987;16:133-135.
22. Johansson J, Lahti A. Topical non-steroidal anti-inflammatory drugs inhibit non-immunologic immediate contact reactions. *Contact Dermatitis*. 1988;19:161-165.
23. Kujala T, Lahti A. Duration of inhibition of non-immunologic immediate contact reactions by acetylsalicylic acid. *Contact Dermatitis*. 1989;21:60-61.
24. Bashir S, Maibach HI. Urticaria, contact syndrome. eMedicine Web site. <http://www.emedicine.com/derm/topic445.htm>. Accessed April 25, 2008.
25. Kanerva L, Hyry H, Jolanki R, et al. Delayed and immediate allergy caused by methylhexahydrophthalic anhydride. *Contact Dermatitis*. 1997;36:34-38.
26. Kim E, Maibach H. Changing paradigms in dermatology: science and art of diagnostic patch and contact urticaria testing. *Clin Dermatol*. 2003;21:346-352.
27. Amin S, Lauerma A, Maibach HI. Diagnostic tests in dermatology. In: Maibach HI, ed. *Toxicology of Skin*. Philadelphia, PA: Taylor & Francis; 2001:389-399.
28. Maibach HI. Regional variation in elicitation of contact urticaria syndrome (immediate hypersensitivity syndrome): shrimp. *Contact Dermatitis*. 1986;15:100.
29. Hostýnek JJ, Lauerma AI, Magee PS, et al. A local lymph-node assay validation study of a structure-activity relationship model for contact allergens [published correction appears in *Arch Dermatol Res*. 1995;287:767]. *Arch Dermatol Res*. 1995;287:567-571.
30. Boussault P, Léauté-Labrèze C, Saubusse E, et al. Oat sensitization in children with atopic dermatitis: prevalence, risks and associated factors. *Allergy*. 2007;62:1251-1256.
31. De Paz Arranz S, Pérez Montero A, Remón LZ, et al. Allergic contact urticaria to oatmeal. *Allergy*. 2002;57:1215.
32. Warner MR, Taylor JS, Leow YH. Agents causing contact urticaria. *Clin Dermatol*. 1997;15:623-635.
33. Burdick AE, Mathias CG. The contact urticaria syndrome. *Dermatol Clin*. 1985;3:71-84.
34. Gollhausen R, Kilgman AM. Human assay for identifying substances which induce non-allergic contact urticaria: the NICU test. *Contact Dermatitis*. 1985;13:98-106.
35. Cancian M, Fortina AB, Peserico A. Contact urticaria syndrome from constituents of balsam of Peru and fragrance mix in a patient with chronic urticaria. *Contact Dermatitis*. 1999;41:300.
36. Yesudian PD, King CM. Severe contact urticaria and anaphylaxis from benzophenone-3 (2-hydroxy 4-methoxy benzophenone). *Contact Dermatitis*. 2002;46:55-56.
37. Tkach JR. Allergic contact urticaria to benzoyl peroxide. *Cutis*. 1982;29:187-188.
38. West I, Maibach HI. Contact urticaria syndrome from multiple cosmetic components. *Contact Dermatitis*. 1995;32:121.
39. Heinemann C, Sinaiko R, Maibach HI. Immunological contact urticaria and anaphylaxis to chlorhexidine: overview. *Exogenous Dermatology*. 2002;1:186-194.
40. Harvell J, Bason M, Maibach HI. Contact urticaria (immediate reaction syndrome). *Clin Rev Allergy*. 1992;10:303-323.
41. Walker SL, Chamers RJ, Beck MH. Contact urticaria due to p-chloro-m-cresol. *Br J Dermatol*. 2004;151:936-937.
42. Orton DI, Wilkinson JD. Cosmetic allergy: incidence, diagnosis, and management. *Am J Clin Dermatol*. 2004;5:327-337.
43. Mathias CG, Chappler RR, Maibach HI. Contact urticaria from cinnamic aldehyde. *Arch Dermatol*. 1980;116:74-76.
44. Niinimäki A, Niinimäki M, Mäkinen-Kiljunen S, et al. Contact urticaria from protein hydrolysates in hair conditioners. *Allergy*. 1998;53:1078-1082.
45. Hostýnek JJ, Maibach HI. Copper hypersensitivity: dermatologic aspects. *Dermatol Ther*. 2004;17:328-333.
46. Torresani C, Periti I, Beski L. Contact urticaria syndrome from formaldehyde with multiple physical urticarias. *Contact Dermatitis*. 1996;35:174-175.
47. Harvell J, Bason M, Maibach H. Contact urticaria and its mechanisms. *Food Chem Toxicol*. 1994;32:103-112.
48. Yamamoto A, Morita A, Tsuji T, et al. Contact urticaria from geraniol. *Contact Dermatitis*. 2002;46:52.
49. Katsarou A, Armenaka M, Ale I, et al. Frequency of immediate reactions to the European standard series. *Contact Dermatitis*. 1999;41:276-279.
50. Schalock PC, Storrs FJ, Morrison L. Contact urticaria from panthenol in hair conditioner. *Contact Dermatitis*. 2000;43:223.
51. Henry JC, Tschen EH, Becker LE. Contact urticaria to parabens. *Arch Dermatol*. 1979;115:1231-1232.
52. Fisher AA. *Contact Dermatitis*. 3rd ed. Philadelphia, PA: Lea & Febiger; 1986:686-709.
53. Draelos ZD. Approach to the patient with cosmetic problems. *Atlas of Cosmetic Dermatology*. Philadelphia, PA: Churchill Livingstone; 2000:1-18.
54. Hardy M, Maibach HI. Contact urticaria syndrome from sorbitan sesquioleate in a corticosteroid ointment. *Contact Dermatitis*. 1995;32:360-361.
55. Blackley CH. *Experimental Researches on the Causes and Nature of Catarrhus Aestivus (Hay Fever and Hay-Asthma)*. London, England: Bailliere, Tindall & Cox; 1873.
56. Indrajana T, Spielsma FT, Voorhorst R. Comparative study of the intracutaneous, scratch and prick tests in allergy. *Ann Allergy*. 1971;29:639-650.
57. Dreborg S, Backman A, Bosomba A, et al. Skin tests used for type I allergy testing. Position paper. *Allergy*. 1989;44(suppl 10):1-59.
58. Fischer T, Bergström K. Evaluation of customers' complaints about sunscreen cosmetics sold by the Swedish pharmaceutical company. *Contact Dermatitis*. 1991;25:319-322.
59. Bauer K, Garbe D, Surlburg H. *Common Fragrance and Flavor Materials: Preparation, Properties and Uses*. 2nd ed. Weinheim, Germany: Wiley-VCH; 1990.
60. Frosch PJ, Kligman AM. The soap chamber test: a new method for assessing the irritancy of soaps. *J Am Acad Dermatol*. 1979;1:35-41. ■