

Allergic contact urticaria secondary to hair dye use

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We describe a case of immediate hypersensitivity to a hair dye, probably resulting from compound allergy.

Case Report

A 64-year-old woman reported four episodes of localized urticaria on her face and neck with associated angioedema shortly after application of a Schwarzkopf hair dye. This always settled within 2 h. Antihistamines were helpful.

The patient was patch tested with a baseline, facial and hairdressing series (supplied by Chemotechnique Diagnostics, Vellinge, Sweden, and Trolab[®] Biodiagnostics, Upton-upon-Severn, UK) by use of the IQ Ultra[™] Chemotechnique patch test chamber system. Allergens were occluded for 48 h, and readings were performed on day (D) 2 and D4 in accordance with ESCD guidelines (1). No positive results were found.

Prick testing was undertaken with *p*-phenylenediamine (PPD) (as supplied by Trolab[®] Biodiagnostics), the colour cream, the developer and an aftercare treatment as supplied by Schwarzkopf, Henkel Beauty Care (Hemel Hempstead, UK). A result was deemed to be positive if the wheal produced was 3 mm greater than that of the negative control. A positive response was seen to the colour cream, with an 8-mm-diameter wheal. The histamine produced an 8-mm wheal, and the normal saline produced no wheal. Prick testing was also performed with the available ingredients of the colour cream, which included resorcinol 1% pet., toluene-2,5-diamine 1% pet., *m*-aminophenol 1% pet., cetyl alcohol 20% pet., benzoic acid 5% pet. (all supplied by Chemotechnique Diagnostics), diethanolamine 2% pet., sodium metabisulfite 1% pet. (both supplied by Trolab[®] Biodiagnostics), and propylene glycol 20% aq. (supplied by Huddersfield

Pharmacy Specials, Calderdale, UK). These all gave negative results; the colour cream was reproducibly positive with an 8-mm wheal, and controls yielded results as above. Prick tests in 5 controls gave negative results with the colour cream.

The manufacturers of the hair dye were contacted and supplied all of the individual constituents of the hair dye for further prick testing; the results are shown in Table 1.

Discussion

Contact urticaria refers to an immediate reaction seen within 30 min of exposure and resolving within hours. This term was initially introduced by Fisher in 1973. Contact urticaria has two mechanisms: immunological and non-immunological. These reactions can produce a spectrum of manifestations, from localized urticaria to anaphylaxis (2, 3). Non-immunological contact urticaria is not fully understood, but vasogenic mediators are released without initiation of immunological pathways, so histamine is not released from mast cells. No prior sensitization is required. Often, the reaction is limited to the site of contact. Common culprits include benzoic acid, cinnamic acid, cinnamal, methyl nicotinate, and dimethylsulfoxide (4).

Hair dye products have been reported to cause irritant, allergic and photoallergic contact dermatitis, as well as contact urticaria. They contain a large number of potent sensitizers that can cause allergic contact dermatitis. PPD has been most widely reported, but other causative agents include toluene-2,5-diamine, *m*-aminophenol, and *p*-aminophenol (5, 6). Resorcinol is present in > 80% of oxidative hair dye products, and is also known as potent sensitizer; however, it is a rare contact allergen (6, 7).

Evidence of type I sensitivity to hair care products is limited to case reports. The reactions reported range from urticaria and angioedema to anaphylaxis. The reactions appear to occur only after oxidation, and seem to be increased with the addition of the oxidant (8, 9). Prick tests or open testing can be used. Goldberg et al.

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Table 1. Constituents of the colour cream (supplied by Henkel Beauty Care UK and Ireland) and reactions to prick testing on two separate occasions [(a) and (b)]

Constituent	Concentration (%)	Vehicle	Reaction (mm) (a)	Reaction (mm) (b)
Histamine	–	–	10	10
Saline	–	–	3	3
Colour cream	'as is'	–	8	8
Carbomer	100	–	3	2
Sodium cetearyl sulfate, sodium sulfate	0.2	aq.	4	3
Glyceryl stearate SE, glycerin, potassium stearate	30.0	pet.	5	2
Octyldodecanol	5.0	pet.	5	3
Cetearyl alcohol	5.0	pet.	5	3
Ceteareth-20	5.0	pet.	5	3
Serine	2.0	aq.	3	2
Linoleamidopropyl PG-dimonium-Cl	1.0	pet.	2	3
Tetrasodium EDTA	1.0	aq.	3	3
Ascorbic acid	1.0	aq.	3	3
Sodium sulfite	2.0	aq.	3	2
Propylene glycol, aqua, fruit extract	5.0	aq.	5	3
<i>Prunus armeniaca</i> kernel oil	100	–	3	3
Citrus aurantium dulcis peel oil, limonene	2.0	pet.	5	2
Toluene-2,5-diamine sulfate	1.0	pet.	4	3
Resorcinol	1.0	pet.	5	3
<i>m</i> -Aminophenol	1.0	pet.	2	3
4-Chlororesorcinol	1.0	pet.	2	3
2,4-Diaminophenoxyethanol-HCl	1.0	pet.	3	2
Fragrance	1.0	aq./ethanol	4	3

identified Bandowski base, an oxidation product of PPD, as the offender (9). Uehara et al. reported a severe contact urticaria syndrome with cardiovascular compromise, related to a PPD derivative, *p*-aminophenol, but also sodium methyl-oleoyl-taurate, a surface active agent (10). Nosbaum et al. described both delayed and immediate hypersensitivity to hair dyes. The culprit allergen was oxidized 2,4-diaminophenoxyethanol-HCl (11). In all of these cases, the causative agents were identified by positive prick test reactions.

Among hairdressers, ammonium and potassium persulfate have been reported to cause immunological and non-immunological contact urticaria. These salts are powerful oxidizers, and therefore help and accelerate the bleaching process (12). There is also a significant risk of inhalation of these chemicals, potentially leading to asthma.

Our patient reacted positively to the unreacted colour cream, but not to any of the individual constituents, suggesting a compound allergy. It is hypothesized this occurs in a product when individual constituents chemically or enzymatically interact, creating a different hapten. Compound allergies to 'essential' or 'incidental' allergens have been described. Essential allergens are always present. Incidental allergens occur

when an external factor plays a role in the generation of the hapten, for example temperature or sun exposure. This can be avoidable if it is understood. Compound reactions have been previously reported with cosmetics and medicaments, but never in hair dye products (13).

In our case, we can hypothesize but not prove a compound allergy, as we have been unable to identify the causative chemicals. Although repeated testing with the individual constituents gave negative results, it is possible that they may have given false-negative reactions. This is the first reported case of contact urticaria being caused by a constituent of a hair dye prior to mixing of the components.

Although contact urticaria caused by hair dye seems to be rare, dermatologists need to be aware of the phenomenon. When the clinical history is consistent with an immediate reaction and patch testing gives negative results, further investigation with prick testing should be undertaken. The concept of compound allergy should be explored when the findings do not mirror the clinical suspicion.

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