

Contact urticaria to cosmetic and industrial dyes

P. Davari and H. I. Maibach

Department of Dermatology, University of California, San Francisco, CA, USA

doi:10.1111/j.1365-2230.2010.03854.x

Summary

Contact urticaria (CU) defines the weal-and-flare reaction that occurs after external cutaneous contact with a causative agent. These reactions often cause discomfort for patients, affect their quality of life, and in severe cases may be life-threatening. Some dyes are known to be urticariogens. Many people have daily exposure to these urticariogens, because of the widespread use of dyes, for example in textiles, cosmetics and foods. We reviewed industrial and cosmetic dyes such as hair dyes, basic blue 99 dye, patent blue dyes, henna, red dyes, curcumin and reactive dyes, which can potentially cause CU. Overall, the reported cases of CU lacked appropriate controls. Hair-dye constituents such as preservatives and intensifiers may play an important role as causative agents of CU. We recommend appropriate protection guidelines to reduce the incidence of CU in high-risk groups such as hairdressers, dye-factory workers or workers in dye-related industries.

Introduction

Contact urticaria (CU) defines the weal-and-flare reaction that occurs after external cutaneous contact with a causative agent. Such immediate reactions occur within minutes to hours after cutaneous exposure to these agents, and usually disappear within a few hours, without residual signs of inflammation. Agents cause CU either through a nonimmunologic mechanism or an immunologic mechanism in people previously sensitized by oral, cutaneous or inhalation exposure. The term was introduced by Fisher in 1973,¹ and CU can be categorized into two vastly different subtypes: immunologic CU (ICU) and nonimmunologic CU (NICU). ICU is a type I hypersensitivity reaction mediated by allergen-specific IgE in a previously sensitized person. It can involve other organs such as the respiratory or gastrointestinal tract, and can cause anaphylactoid shock and death. NICU is a less severe disease, which mainly presents as localized urticarial reactions.² Agents that

cause NICU directly stimulate the release of vasoactive substances such as histamine from mast cells. Substance A, bradykinin, leucotrienes and prostaglandins may be involved in the pathogenesis of NICU.² Eicosanoids may also be involved.³

Maibach and Johnson introduced the term 'CU syndrome' to describe multisystem involvement in CU. Both ICU and NICU can be a component of CU syndrome. The authors suggested four stages for ICU: stage 1 is defined as localized urticaria or includes nonspecific symptoms such as itching, tingling and burning; stage 2 presents generalized urticaria; stage 3 has extracutaneous involvement; and anaphylactic shock occurs in stage 4.⁴

Dyes are widely used as colouring agents in a range of products including cosmetics, foods, medications and textiles. Hence, numerous people have daily exposure to dyes in their personal and professional life. This review focuses on industrial or cosmetic dyes as potential cause of CU syndrome. The included studies are summarized in Table 1.

Types of dye likely to cause a reaction

Hair dyes

Dogra *et al.* evaluated adverse reaction to cosmetics in 50 suspected cases. In that study, four patients were

Correspondence: Dr Parastoo Davari, 110 Surge Bldg. 90 Medical Center Way, University of California, San Francisco, CA, USA
E-mail: davaripa@yahoo.com

Conflict of interest: none declared.

Accepted for publication 11 January 2010

Table 1 Summarized data on dyes.

Dye (or constituent)	Clinical findings	Skin test results	Ref. no.
Hair dyes	History of adverse reaction to cosmetics	4/50 patients found to have CU after patch testing with hair dyes	5
Hair dyes	Anaphylactoid reaction	Challenge test with the dye caused generalized urticaria and anaphylactoid reaction	6
Henna	Swelling of face, generalized urticaria, and wheezing	Prick test with henna 1% was positive	7
Henna	Urticaria rhinitis, and bronchial asthma	Prick test with henna 1% was positive	8
Henna	Urticaria	Prick test with 1% henna was positive	11
Henna	Erythema, oedema, itching and papulovesicular eruptions	Positive patch test	12
Basic blue 99 dye	Weals and itching sensation	Patch test after 1 day and scratch test after 20 min showed positive results for the lotion-hair dye and 1% basic blue 99	13
Patent blue	Pruritus, urticaria, angio-oedema, and anaphylactic reaction	Skin tests with patent blue and methylene blue were positive	15
Patent blue	Itching and anaphylactic shock in one patient, and blue hives in another patient after intradermal injection of patent blue	Not provided	16
Isosulfan blue	Urticaria after intradermal injection of isosulfan blue	Not provided	17
Patent blue	Immediate erythematous urticarial rash	Not provided	18
Red dyes	Erythema, itching and swelling of hands and forearms	Patch test was positive to E124 (ponceau 4R, cochineal red A) and E129 (allura red AC)	19
Curcumin	NICU in one patient. IgE-mediated hypersensitivity after performing prick test in a normal control	Prick test was positive to curcumin	22
Reactive dyes	Urticaria or Quincke oedema in 3 of 162 employees exposed to reactive dyes	Positive prick test with reactive dyes in one patient and with standard allergen in another patient	25
Reactive dyes	Diffused urticaria, asthma and elevated IgE in one patient	Prick test was positive to Lanazol yellow 4G (a bromoacrylic dye)	26
Reactive dyes	Urticaria and respiratory symptoms	Prick test and/or scratch tests were positive to Remazol Gold Gelb RNL and Drimaren Scharlach K 2G	27
Textile dyes	Persistent erythematous weal type or transient urticarial dermatitis in 7/100 of patients and itching in 4/100 of patients due to textile dyes	Not provided	29

Ref, reference.

found to have CU after patch testing with hair dyes.⁵ Generalized CU followed by anaphylactoid reaction was reported after use of a synthetic hair dye.⁶ It seems that hair-dye ingredients such as preservatives and intensifiers may play an important role as causative agents of CU.

Henna. Derived from the leaves of the shrubs *Lawsonia alba* or *Lawsonia inermis*, henna is used as a cosmetic to stain hair, nails and skin. Case reports of immediate hypersensitivity to henna were documented in two hairdressers, who had symptoms such as rhinitis, conjunctivitis, sneezing, urticaria and wheezing. Prick test results with henna 1% were positive in both cases, although it was negative for 2-hydroxy-1, 4-naphthoquinone, the active component of henna, in one

case. This may suggest that there is another responsible ingredient for henna allergic reaction.^{7,8}

Other hairdressers have developed rhinitis, conjunctivitis and asthmatic symptoms after exposure to henna. All had a positive prick test with henna. As henna powder particles are light and can spread in the air, the symptoms may be evoked by these tiny particles taken in through the respiratory tract or skin.^{9,10}

An Ig-E mediated hypersensitivity and a positive prick test from a commercial henna extract was reported.¹¹ Erythema, oedema, itching and papulovesicular eruptions were seen in two cases immediately after application of a henna tattoo.¹²

Basic blue 99. This substance is usually used in temporary or semipermanent hair dyes. It is associated

with ICU. Jagtman reported an atypical case who experienced weals and itching sensation 3 days after applying a hair-dye lotion containing basic blue 99. A positive reaction was seen 1 day after patch testing and 20 min after scratch testing to the hair-dye lotion and to 1% basic blue 99. Despite the delay in occurrence of symptoms, the author used the term 'CU' for diagnosis.¹³ Although it is stated that delayed-onset urticaria may not produce symptoms for up to 4–6 h, which may be the result of slower percutaneous penetration,¹⁴ the 3-day delay in this case suggests it may not have been CU and requires explanation. Commercial grades of this dye may have multiple impurities, whose immunogenicity has not been studied.

Patent blue

Blue dyes are used for sentinel node biopsy. Several reports have documented adverse effects such as urticaria and anaphylactoid reactions after intravenous or subcutaneous injection of patent blue. Urticaria, erythema, angio-oedema and hypotension occurred in a few patients after intradermal injection of patent blue.^{15,16} Skin tests gave positive reactions to patent blue and methylene blue, indicating crossreaction between these two dyes.¹⁵ Urticarial lesions have been reported after intradermal injection of isosulfan blue, which is the 2, 5-disulphonated isomer of patent blue.¹⁷

Immediate occurrence of an erythematous urticarial rash on the face was reported after topical use of patent blue as a disclosing tablet to reveal dental plaque.¹⁸ In this case, it seems that the dye was absorbed through the oral mucosa, but absorption through the skin on the lips was possible.

Red dyes

ICU presenting as erythema, itching and swelling of hands and forearms occurred in a 3-year-old boy with atopy who had been playing with red-coloured play dough. A 20–40 min open patch test with coloured play doughs, foods and antibiotic syrups resulted in positive reactions to E124 (ponceau 4R, cochineal red A) and E129 (allura red AC).¹⁹

Curcumin

Curcumin is derived from the rhizome of *Curcuma longa* (turmeric) and is used in foods, traditional medicine and fur dyes. Type I allergy to spices is common.^{20,21} Liddle *et al.* reported a case of occupational NICU to curcumin,

which was confirmed by a positive prick test. They also found a case with IgE-mediated hypersensitivity (ICU) after performing prick test in 15 normal controls with no previous history of allergy to curcumin.²²

Reactive dyes

Reactive dyes are used in dyeing cellulose fibres, nylon and wool, and can cause allergic reactions. Reactive dyes, which cause allergic reactions are described.^{23,24} Urticaria was noted as one of the skin symptoms of dye-factory workers using reactive dyes.²⁵ One worker handling reactive dyes had diffuse urticaria and asthma and an increased IgE level. Skin test was positive to Lanasol yellow 4G (a bromoacrylic dye).²⁶ Positive reactions have been reported after scratch and/or prick tests with the monoazo class of reactive dyes (Remazol Gold Gelb RNL and Drimaren Scharlach K 2G) in patients who had urticaria and respiratory symptoms after handling reactive dyes.²⁷ As in case of many dyes, immunochemical identification (parent component and/or impurity) awaits clarification.

Textile dyes

Allergic dermatitis is the typical presentation of textile dyes. However, other clinical pictures such as diffuse pruritus and urticaria are seen.²⁸ Seidenari *et al.* presented 100 subjects sensitized to textile dyes. They reported different clinical pictures including persistent erythematous weal type or transient urticarial dermatitis in seven patients and itching in four patients due to textile dyes, but they did not specify the dyes caused such reactions.²⁹

Conclusion

This review confirms that various dyes can cause a broad spectrum of clinical presentations. Severe contact dermatitis (type IV hypersensitivity) may sometimes have an urticarial picture, which is often mistaken for CU. Overall, the reported cases of CU reviewed lacked appropriate controls. Such reactions produce different levels of discomfort for patients, affect their quality of life or work, or even become life-threatening. ICU may lead to dermatitis or eczema.

As Kligman³⁰ reported, CU is underdiagnosed, and more awareness is needed. Appropriate protection guidelines can be helpful to reduce the incidence of CU in high-risk groups, such as hairdressers, dye-factory workers and workers in dye-related industries. Patients with a history of burning sensation, stinging, itching,

redness or urticaria within an hour of exposure should receive immediate testing. Epidermal application of the agents (open and occlusive tests) followed by prick test if the results are negative, is recommended for such patients. Agents should not be applied at high doses when testing if hypersensitivity type II and IV reactions are suspected, and resuscitation facilities should be available.

Large-scale prospective studies of patients with a history of burning sensation, stinging and itching within an hour of handling known allergens is needed to confirm the prevalence of CU.

Learning points

- Dyes are widely used as colouring agents in cosmetics, foods, medications and textiles. They can cause a broad spectrum of clinical pictures including CU.
- Hair dyes, basic blue 99 dye, patent blue dyes, henna, red dyes, curcumin and reactive dyes have all been reported as inducers of CU.
- It is likely that hair-dye constituents such as preservatives and intensifiers play an important role as CU causative agents.
- In many dyes, immunochemical identification (parent component and/or impurity) awaits clarification.
- Overall, the reported CU cases reviewed lacked appropriate controls.
- Appropriate protection guidelines can be helpful to reduce the incidence of CU in high-risk groups.
- Patients with a history of burning sensation, stinging, itching, redness or urticaria within an hour of exposure should receive immediate testing.

References

- 1 Fisher AA. *Contact Dermatitis*, 2nd edn. Philadelphia: Lea & Febiger, 1973.
- 2 Amado A, Jacob SE. Contact allergy to food. *Actas Dermosifiliogr* 2007; **98**: 452–8.
- 3 Wakelin SH. Contact urticaria. *Clin Exp Dermatol* 2001; **26**: 132–6.
- 4 Maibach HI, Johnson HL. Contact urticaria syndrome. Contact urticaria to diethyltoluamide (immediate-type hypersensitivity). *Arch Dermatol* 1975; **111**: 726–30.
- 5 Dogra A, Minocha YC, Kaur S. Adverse reactions to cosmetics. *Indian J Dermatol Venereol Leprol* 2003; **69**: 165–7.
- 6 Mavroleon G, Begishvili B, Frew AJ. Anaphylaxis to hair dye: a case report. *Clin Exp Allergy* 1998; **28**: 121–2.
- 7 Cronin E. Immediate-type hypersensitivity to henna. *Contact Dermatitis* 1979; **5**: 198–9.
- 8 Majoie IM, Bruynzeel DP. Occupational immediate-type hypersensitivity to henna in a hairdresser. *Am J Contact Dermat* 1996; **7**: 38–40.
- 9 Pepys J, Hutchcroft BJ, Breslin ABX. Asthma due to inhaled chemical agents. Persulphate salts and henna in hairdressers. *Clin Allergy* 1976; **6**: 399–404.
- 10 Starr JC, Yunginger J, Brahser GW. Immediate type I asthmatic response to henna following occupational exposure in hairdressers. *Ann Allergy* 1982; **48**: 98–9.
- 11 Bolhaar ST, Mulder M, van Ginkel CJ. IgE-mediated allergy to henna. *Allergy* 2001; **56**: 248.
- 12 Onder M, Atahan CC, Oztas P, Oztas MO. Temporary henna tattoo reactions in children. *Int J Dermatol* 2001; **40**: 577–9.
- 13 Jagtman BA. Urticaria and contact urticaria due to basic blue 99 in a hair dye. *Contact Dermatitis* 1996; **35**: 52.
- 14 Von Krogh G, Maibach HI. The contact urticaria syndrome – an updated review. *J Am Acad Dermatol* 1981; **5**: 328–42.
- 15 Keller B, Yawalkar N, Pichler C *et al.* Hypersensitivity reaction against patent blue during sentinel lymph node removal in three melanoma patients. *Am J Surg* 2007; **193**: 122–4.
- 16 Cohen S, Ad-El D, Erez E, Gutman H. Beware of the blue hives. *Dermatol Surg* 2008; **34**: 400–2.
- 17 Leong SP, Donegan E, Heffernon W *et al.* Adverse reactions to isosulfan blue during selective sentinel lymph node dissection in melanoma. *Ann Surg Oncol* 2000; **7**: 361–6.
- 18 Chadwick BL, Hunter ML, Evans MT, Hunter B. Allergic reaction to the food dye patent blue. *Br Dent J* 1990; **168**: 386–7.
- 19 Baron SE, Moss C. Contact urticaria to play dough: a possible sign of dietary allergy. *Br J Dermatol* 2004; **151**: 945–7.
- 20 Cronin E. Dermatitis of the hands in caterers. *Contact Dermatitis* 1987; **17**: 265–9.
- 21 Lahti A, Basketter D. Immediate contact reactions. In: *Textbook of Contact Dermatitis* (Rycroft R, Menné T, Frosch P, Lepoittevin JC, eds). Berlin: Springer-Verlag, 2001; 111–32.
- 22 Liddle M, Hull C, Liu C, Powell D. Contact urticaria from curcumin. *Dermatitis* 2006; **17**: 196–7.
- 23 Docker A, Wattie JM, Topping MD. Clinical and immunological investigations of respiratory disease in workers using reactive dyes. *Br J Ind Med* 1987; **44**: 534–41.

- 24 Topping MD, Forster HW, Ide CW *et al.* Respiratory allergy and specific immunoglobulin E and immunoglobulin G antibodies to reactive dyes used in the wool industry. *J Occup Med* 1989; **31**: 857–62.
- 25 Nilsson R, Nordlinder R, Wass U *et al.* Asthma, rhinitis, and dermatitis in workers exposed to reactive dyes. *Br J Ind Med* 1993; **50**: 65–70.
- 26 Romano C, Sulotto F, Pavan I *et al.* A new case of occupational asthma from reactive dyes with severe anaphylactic response to the specific challenge. *Am J Ind Med* 1992; **21**: 209–16.
- 27 Estlander T. Allergic dermatoses and respiratory diseases from reactive dyes. *Contact Dermatitis* 1988; **18**: 290–7.
- 28 Belsito DV. Textile dermatitis. *Am J Contact Dermat* 1993; **4**: 249–52.
- 29 Seidenari S, Manzini BM, Danese P. Contact sensitization to textile dyes: description of 100 subjects. *Contact Dermatitis* 1991; **24**: 253–8.
- 30 Kligman AM. The spectrum of contact urticaria. Wheals, erythema, and pruritus. *Dermatol Clin* 1990; **8**: 57–60.