

Concomitant long-lasting allergic patch test reactions to *p*-phenylenediamine and textile azo dyes

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Long-lasting allergic patch-test reactions (LLAPTRs) are positive reactions at days 2–7 that remain positive for weeks or months.¹ The causal mechanisms are thus far largely unknown.

CASE REPORT

A 22-year-old non-atopic female office worker experienced an itching eruption on the scalp after application of a permanent hair dye. This resolved slowly in the course of more than 2 months after onset, despite local corticosteroid therapy. She reported being allergic to nickel and cobalt. Patch tests were carried out with the European baseline series and the hair-dye ingredients, including *p*-phenylenediamine (PPD) (Chemotechnique Diagnostics, Vellinge, Sweden). The test substances were applied to the upper back using van der Bend Square Chambers (Van der Bend, Brielle, The Netherlands) or 2 days. Readings were performed on day (D)3 and D7, according to ESCD guidelines. The patient showed positive reactions to textile dye mix (TDM), PPD, nickel sulfate, and cobalt chloride (Table 1). At D15, she returned due to the persistence of the two patch tests that were positive to PPD and TDM. The subsequent checks of these reactions are reported in Table 1. Thirty-four days after application of the previous tests, additional patch tests with the eight individual ingredients included in the TDM (Chemotechnique Diagnostics) were performed. The additional patch tests gave positive reactions to the azo dyes Disperse Red 1 (DR1), Disperse Orange 3 (DO3), and Disperse Yellow 3 (DY3) (Table 1). However, no clinical history of textile dye dermatitis was reported. These reactions, interpreted as cross-reactions between PPD and the azo dyes, presented a long-term persistence

as LLAPTRs, similar to what was observed for the TDM and PPD (Table 1).

DISCUSSION

Some azo dyes, such as DO3, DY3, and DR1, among others, have been reported to frequently cross-react with PPD.² A similarity in molecular structure (true cross-sensitivity) or a metabolic conversion of the azo dyes to PPD were considered as possible explanations. The dyes that are least likely to cross-react with PPD are non-azo dyes, which cannot be broken down by the skin azo-reductase enzymes to yield PPD.²

LLAPTRs to PPD and DY3 have been described.^{3,4} However, there are no reported cases of LLAPTRs to DO3 and DR1. Skin persistence of the allergen and/or defective downregulation of the cell-mediated immune response have been hypothesized as possible causes for LLAPTRs.

In a study on dose-time relationship for elicitation reaction to PPD in sensitized subjects, White et al demonstrated that, over the time period tested, the allergenic component of PPD accumulates in the skin.⁵ This was corroborated in the same study by skin-binding data showing persistence of radiolabeled PPD following repeated application on rat skin.

The LLAPTR-inducing azo dyes in our case may be degraded to PPD in the skin by the azo-reductase enzymes.² Consequently, the skin persistence of PPD could hypothetically have contributed to the occurrence of the LLAPTRs, both to PPD and to the azo dyes showing PPD as their metabolic derivative.

According to Bygum and Andersen, LLAPTRs seem to be more frequent in patients with multiple strong positive reactions.¹ In contrast, in our experience—referring to just one case—LLAPTRs involve multiple reactions, all being initially weak positive. Similar to what was observed for LLAPTRs to PPD, the eruption following the application

TABLE 1 Patch-test results

	D3/D7	D15	D34	D37/41	D60
Allergens of the European baseline series					
PPD 1% pet.	+/+	+	+	+/+	—
TDM 6.6% pet.	+/+	+	+	+/+	—
Nickel sulfate 5% pet.	++/+	—	—	—/—	—
Cobalt chloride 1% pet.	+/+	—	—	—/—	—
Ingredients of the hair dye (excluding PPD)	—/—	—	—	—/—	—
Ingredients of the TDM					
DO3 1% pet.			AT	+/+	+
DY3 1% pet.			AT	+/+	+
DR1 1% pet.			AT	?+/+	+

Abbreviations: AT, additional test application 34 days after initial test; D, day; DO3, Disperse Orange 3; DR1, Disperse Red 1; DY3, Disperse Yellow 3; pet., petrolatum; PPD, *p*-phenylenediamine; TDM, textile dye mix.

of the hair dye also presented a long-term evolution, despite corticosteroid treatment.

AUTHOR CONTRIBUTIONS

Giuseppe Mancuso: Conceptualization; data curation; formal analysis; writing-original draft; writing-review and editing.

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REFERENCES

- Bygum A, Andersen KE. Persistent reactions after patch testing with TRUE test panels 1 and 2. *Contact Dermatitis*. 1998;38(4):218-220.
- Goon AT, Gilmour NJ, Basketter DA, White IR, Rycroft RJ, McFadden JP. High frequency of simultaneous sensitivity to Disperse

Orange 3 in patients with positive patch tests to para-phenylenediamine. *Contact Dermatitis*. 2003;48(5):248-250.

- Patrizi A, Lanzarini M, Tosti A. Persistent patch test reactions to textile dyes. *Contact Dermatitis*. 1990;23(1):60-61.
- Uchida S, Oiso N, Matsunaga K, Kawada A. Patch test reaction to *p*-phenylenediamine can persist for more than 1 month. *Contact Dermatitis*. 2013;69(6):382-383.
- White JM, Basketter DA, Pease CK, Sanders DA, McFadden JP. Intermittent exposure to low-concentration paraphenylenediamine can be equivalent to single, higher-dose exposure. *Contact Dermatitis*. 2007;56(5):262-265.

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