

The effect of patch duration on the elicitation of para-phenylenediamine contact allergy

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To study the length of exposure time required to elicit para-phenylenediamine (PPD) allergic reactions, patients known to be allergic to PPD were recruited and patch tested. A group of 7 patients were patch tested with 1% PPD in pet. for 15 min, 30 min and for 120 min. The remaining 9 patients were patch tested with 1%, 0.3%, 0.1% and 0.01% PPD for 15 min, 30 min and for 120 min each. With exposure for 120 min, 11 of 16 subjects reacted to 1% PPD and 2 of 9 reacted to 0.01%. With exposure of 15 min, 6 of 16 reacted to 1% PPD and 0 of 9 reacted to 0.01% PPD. This study showed marked inter-individual variability in eliciting a reaction to the PPD molecule on patch testing, with regard to both the exposure time and the concentration required.

Key words: para-phenylenediamine; allergic contact dermatitis; elicitation time; duration of application; patch testing; inter-individual variability. © Munksgaard, 1998.

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Use of permanent hair dyes can give rise to allergic contact dermatitis in both hairdressers and their clients (1). Although much work has been performed looking at the concentrations of para-phenylenediamine (PPD), other skin sensitizing hair dyes and indeed many other contact allergens which may elicit reactions, the exposure time and dose/time relationship has not yet been explored. Knowledge of these parameters is important for the implementation of a thorough risk assessment for such skin sensitizing chemicals in order to determine safe use conditions. Consequently, in this study, we have recruited subjects previously sensitized to PPD and studied the relationship between concentration, duration of application, and elicitation of an allergic skin response.

Materials and Methods

16 subjects were recruited, 8 male and 8 female, age range 17–65 years. All had previously had a positive PPD elicitation reaction on routine testing. In 9 of these subjects, PPD 0.01%, 0.1%, 0.3% and 1% in petroleum (pet.) was applied for 15 min, 30 min and 120 min using 8 mm Finn Chambers

(Epitest, Finland). The remainder were tested with 1% pet. only. The skin was gently cleaned immediately after the patch applications were removed. Elicitation reactions were read at 2 and 4 days using a – to +++ (ICDRG) scale.

Results

Results are shown in Table 1 and Fig. 1. With 1% PPD, there was a significant number who reacted after 15 min; the majority reacted within 120 min, though 5 gave no reaction at any concentration. With varying concentrations, there was a wide range of reactivity, with 6 subjects giving a clear reaction at 15 min. However, what was apparent was that for certain individuals the intensity of the reaction evinced by short duration was not noticeably weaker than that resulting from longer contact.

Discussion

PPD is a potent contact allergen. At 10%, it sensitized all 24 subjects exposed in a human maximization test, and each reacted to a challenge of 0.5%

Table 1. Summary of patch test results with PPD

Exposure time (min)	PPD concentration	Subject no.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
15	1%	—	—	—	—	+	+	—	++	++	—	—	—	—	—	+	+++
	0.30%	—	—	—	—	+	—	—	+	++	NT	NT	NT	NT	NT	NT	NT
	0.10%	—	—	—	—	—	—	—	+	+	NT	NT	NT	NT	NT	NT	NT
	0.01%	—	—	—	—	—	—	—	—	—	NT	NT	NT	NT	NT	NT	NT
30	1%	—	—	—	+	+	+	+	++	++	—	—	—	—	—	+	+++
	0.30%	—	—	—	+	—	—	—	++	++	NT	NT	NT	NT	NT	NT	NT
	0.10%	—	—	—	—	—	—	—	+	++	NT	NT	NT	NT	NT	NT	NT
	0.01%	—	—	—	—	—	—	—	—	—	NT	NT	NT	NT	NT	NT	NT
120	1%	—	—	+	+	+	+	+	++	++	—	—	—	+	+	++	+++
	0.30%	—	—	+	—	+	+	+	++	++	NT	NT	NT	NT	NT	NT	NT
	0.10%	—	—	—	—	+	—	—	++	++	NT	NT	NT	NT	NT	NT	NT
	0.01%	—	—	—	—	—	—	—	+	+	NT	NT	NT	NT	NT	NT	NT

(2). It is also strongly positive in a number of other predictive assays (3). Rate limiting factors for elicitation of an allergic reaction would consist of absorption of the PPD through the skin barrier into the epidermal component, metabolic breakdown of the free PPD base (4), and the relative allergic sensitivity of the subject. In this latter case, it is reasonable to speculate that those with more reactivity to the allergen would need either less exposure time or a lower dose. The formation of (a) common intermediate(s) may allow for some degree of cross-reactivity with other similarly substituted benzenes (5, 6). Subjects have been shown to react to lower concentrations of metabolic breakdown products of PPD than to the actual PPD molecule itself (7).

This study shows that there is great inter-individual variability in the elicitation of an allergic reaction to the PPD molecule. Some individuals

reacted after only 15 min contact, and certain of these might reasonably be expected to be capable of reacting after even shorter contact times. The actual times involved in elicitation may vary with method of application. In the presence of an irritant or if applied onto already inflamed skin, the time required to achieve a clinically visible reaction would be further reduced. Certainly, sensitization can vary with how the PPD is applied (8). Reported evidence shows that individuals allergic to cinnamic aldehyde were capable of reacting after 20 min skin contact (9), whilst Bruze and co-workers demonstrated that most nickel-sensitive individuals could be identified using a 5 h patch test (10). To summarize, time of exposure to contact allergens such as PPD to elicit allergic contact dermatitis reactions may be very brief and this needs to be taken into account when evaluating dose-response data.

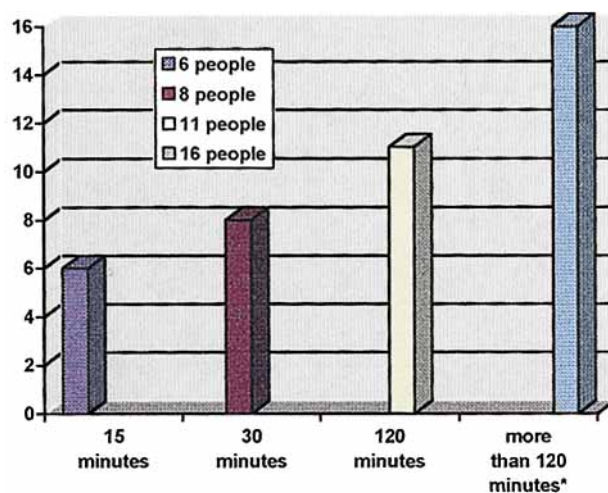


Fig. 1. Exposure time and elicitation reaction to PPD 1%. *All patients had previously reacted to PPD 1% (2-day exposure) on standard patch testing.

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