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Hair dyes and temporary tattoos are a real hazard for adolescents?

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Summary

Temporary tattoos, especially those that contain black dyes, have become rampant among teenagers in recent years. Most of these tattoos, in addition to hair dyes include paraphenylenediamine (PPD). PPD is a well-known skin sensitizer, which causes allergic contact dermatitis. Allergic contact dermatitis skin lesions from PPD are mostly seen as erythema multiforme-like eruption, a bullous contact dermatitis or as an exudative erythema. Herein, we report on our finding on a 15 year-old adolescent female who had been unaware of being previously sensitized to PPD from a black henna tattoo, and angioedema-like reaction which occurred after her first exposure to hair dye.

Introduction

In hairdressing, the main contact allergen is PPD, followed by its derivatives paratoluenediamine, para-aminodiphenylamine and o-nitrop-phenylenediamine (1). Although pure henna is known to be harmless, the addition of PPD, which gives a darker brown to black color and is sometimes used to speed up the process of hair dyeing with henna, yields what is called the black henna mixture (2-4). Herein, we will discuss our finding, regarding a 15 year-old woman with an angioedema-like reaction that occurred after her first exposure to hair dye. She came to us, unaware of having been previously sensitized to PPD by a black henna tattoo she had received a year before on her left forearm, which, at the time, had caused an allergic reaction.

Case report

A 15 year-old adolescent female presented herself at Erciyes University Pediatric Emergency Services with severe edema involving the upper and lower eyelids, the forehead, scalp and face (**figure 1**). She consulted with our allergy department and was initially diagnosed with angioedema. After using hair dye for the first time in her life, one hour later pruritus started on her scalp, forehead and face. Two days after the exposure occurred, she also experienced severe edema on the scalp, forehead, upper and lower eyelids and face. We started methylprednisolone, H1 (cetirizine, hydroxyzine), H2 (ranitidine) for 5 days. After the 7 days of medication**,** clinical improvement was observed (**figure 2**). She described an allergic reaction in the application area (pruritic, erythematous, edematous reaction) of a black henna tattoo she had on her left forearm one year earlier. We performed a patch test including the European standard series

(True test®) of allergens on the patient 2 weeks after the end of the medication. At the end of the 48 hours a positive result to PPD with bullous reaction on erythematous test area was observed (**figure 3**). She and her family were told that she had an allergy to PPD and cross-reacting substances. We cautioned her about dyeing her hair with any products containing PPD or other para-dye ingredients, and to avoid getting black henna tattoos. A list of products that may contain PPD or cross-react with it was also given.

Figure 1 *- Severe edema of eyelids and frontal area extending to the scalp*

Figure 2 *- Clinical improvement after management*

Figure 3 *- Positive patch test result to Paraphenylenediamine*

Discussion

Allergic contact reactions according to hair dyes occur mostly due to the sensitization to PPD. Sensitization to PPD derivatives could cause cross-reactions. As an ingredient, PPD has several applications, including the coloring used in fabric dyes, rubber, lacquers, leather, eye shadow, and shoe polish. It has also been used as an antioxidant in fax machines, photographic products, plastics, printing ink, and liquid for x-ray film, as well as in lithography (1,2). Prevalence of PPD sensitization based on population patch test studies in Europe has been found to be between 0.1% and 1% (5). In temporary henna tattoos, the PPD concentration has been shown to be as high as 15.7%, which is much stronger than the concentrations used in hair dyes (4). In most of the samples, the PPD concentration was higher than is recommended for hair dyes. Acute effects, caused by short-term exposure to high levels of PPD, may include eye irritation and tearing, severe dermatitis, renal failure, asthma, gastritis, vertigo, convulsions, tremors and coma in humans (6). Kligman reported that a single application of 10% of 1.0 mL solution would sensitize about 80% of the population (7). Combined with the extended period of skin exposure without neutralization, higher PPD concentration causes potent skin sensitization to PPD (8). Oxidative hair dyes (permanent hair dyes) contain primary intermediates (such as PPD) and couplers. When mixing intermediates and couplers, the primary intermediates initially react with hydrogen peroxide (neutralizing agent) to form a diimine, and the diimine then reacts with couplers to form dinuclear, trinuclear or polynuclear structures. Unreacted primary intermediates and couplers (small molecules) diffuse into hair, start coupling reactions and then become trapped in hair and increase the risk of skin sensitization (9). Even in low concentrations such as those in hair dyes, subsequent exposure to PPD can then result in a delayed type-IV hypersensitivity reaction, manifesting as an acute contact dermatitis (4). These contact dermatitis symptoms usually begin after the initial application (10). Contact dermatitis associated with PPD in hair dye often extends beyond the scalp to include the forehead, neck, eyelids and face. It usually manifests as pruritic, edematous, erythematous scaly patches and plaques; vesicular lesions sometimes occur as well (4). Differential diagnosis for the hair dye allergic reactions includes contact urticaria syndrome and angioedema that appears immediately (mostly within 5-20 min, exceptionally later) upon contact with the causal agent (11). We excluded these diseases because the reaction occurred 2 days after the hair dye exposure in our patient. In the literature, it is reported that 'contact dermatitis with severe scalp swelling and upper airway (is compromised) due to black henna hair dye' (12). In the literature the reports of hair loss in the scalp due to hair dyes containing PPD is rare, citing only two reported cases (13). In our patient, only a severe edema from scalp to forehead, upper and

lower eyelids, and face was prominent initially and a misdiagnosis of angioedema was made in the pediatric emergency room. Positive allergic reaction to PPD was confirmed with the patch test bullous reaction on the erythematous test area. Our patient was a 15 year-old, had applied hair dye for the first time in her life and the sensitization phase of allergic reaction had been initiated by a black henna tattoo which had been performed one year before. An angioedema-like reaction occurred two days after hair dyeing, supporting a delayed type of hypersensitization. Therefore, patch tests results confirmed this relationship between hair dye and black henna tattoos.

We concluded that the patients with severe edematous reactions after the first application of a hair dye might have previously been sensitized from other PPD-containing materials. Black henna tattoos contain PPD. It may sensitize users. Allergic contact dermatitis ought to be considered in patients presenting with angioedema. Patch testing should be done on patients who react to hair dyes (PPD and its derivatives) to elucidate the cause and to prevent further severe reactions.

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