

RESEARCH ARTICLE

Allergic reactions to henna-based temporary tattoos and their components

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Abstract

Temporary henna-based tattoos, particularly popular among western tourists holidaying in exotic places, can expose to the risk to develop allergic reactions. Although hypersensitivity to henna is extremely rare, para-phenylenediamine, which is sometimes added to henna to obtain a dark, blackish color, is a frequent contact sensitizer. The purpose of this article is to review the literature about allergic reactions to temporary henna tattoos and outline the causes, clinical aspects and complications of this practice that should not be regarded as innocuous and risk-free.

Keywords: Adverse effects; allergic contact dermatitis; henna; paraphenylenediamine; textile dyes

Introduction

The word tattoo derives from two Polynesian words *Tae* and *Toua* or *Tau*, that mean spirit and drawing. In Tahiti the word *Tatau* or *Tattoo* is translated as “drawing, decorating the skin.” In various cultures, over the centuries tattoos have taken on different, sometimes opposite meanings. For the Maori, facial tattoos denoted the class, profession, social status and family of origin, whereas the Greeks and Romans used them to brand criminals and slaves.⁽¹⁾ The early Christians used small body tattoos representing a cross, a lamb or a fish as signs of recognition but already by 787 AD a papal Bull had condemned the use of tattoos because “man should not disfigure his body made in God’s image.”⁽¹⁾ In later centuries the art of tattooing was practised only by a minority of people, mostly adventurers, sailors, soldiers, prostitutes, and criminals.⁽¹⁾

However, the practice has recently spread once more, this time in the form of temporary henna-based tattoos,

that are particularly popular among western tourists holidaying in exotic places.⁽²⁾

Henna-based tattoos

Henna is a dark green powder obtained from the dried, ground leaves and stalk of *Lawsonia inermis* (of the *Lythraceae* family), a bush that grows to a height of between 2 and 6 m and has small flowers that may be white (*alba* variety), pink or red (*rubra* variety), and have an intense, sweet scent. The plant is mainly cultivated in Africa, South East Asia and India with a warm, damp climate. The bush was identified and catalogued by the great Swedish naturalist Linnaeus, and named after his assistant, the Scottish doctor Isaac Lawson, who was a member of the scientific expedition.

Mixed with water or oil, henna takes on a creamy consistency and reddish-brown color; when it is applied and left on the skin or hair for several hours it dyes them

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a characteristic orangey-brown. The art of decorating the hands and feet with henna-based tinctures is widely practised in the Arab, African, and Indian world, and is a traditional part of public festivities such as weddings or religious ceremonies. In India, in particular, the use of henna to create complex pictures on the skin is an ancient art known as *mehindi* or *mehandi*. On important occasions it is customary to decorate the body in this way. This is especially true for weddings, when the bride is adorned with complex geometric, symmetrical figures depicting flowers, plants or animals on the night before the ceremony, while intoning *mehindi* chants, considered to bring good luck.

The dye is applied using semiconical containers, to make it easier to achieve the elaborate designs, and left on for 3–6 h; the longer the exposure time the darker the final color.⁽³⁾

Henna powder is used for cosmetic purposes to dye and nourish the hair (that takes on a typical reddish-brown tinge) and nails. In the industrial sector the powder is used above all by Muslims and Orthodox Jews because they refuse to use synthetic dyes to tinge silk, wool, and cotton fabrics.⁽³⁾ The active substance in henna responsible for the dye properties is lawsone, a hydroxy-1,4-naphthoquinone.

To accelerate drying process of henna tattoos on the skin, henna is generally mixed with other substances, such as ground coffee, tannins, tea leaves, lemon juice, vinegar, eucalyptus oil, and other selected “secret” ingredients chosen by mehindi artists according to their own experience.⁽⁴⁾ In the last few years it has become a common practice to associate henna with paraphenylenediamine (PPD), a synthetic dye that accelerate drying process of henna tattoos on the skin, as well as inducing a darker, more brilliant hue. This blend is known as “*black henna*” to distinguish it from the original henna, known as “*red henna*.” However, the term black henna can be confusing because this same term is used to indicate the powder of another bush, *Indigofera argentea* (of the *Fabaceae* family), that is a distinct botanical species.⁽⁵⁾ PPD is a powerful contact allergen that can also induce sensitization even after a single exposure.⁽⁶⁾

Allergic reactions to temporary tattoos

Causes

Henna is the main ingredient of temporary tattoos; it has a very minor sensitizing power. In fact, although it has been used for centuries for ritual purposes by Moslem peoples and in religious practices in the Far East, reports of hypersensitivity reactions to pure henna are extremely rare.^(7,8) Such cases are generally attributable to occupational immunoglobulin E (IgE)-mediated reactions in

hairdressers, that can induce both respiratory and skin symptoms (rhino-conjunctivitis, asthma, urticaria),^(9–11) and even anaphylaxis.⁽⁸⁾

Instead, PPD is notoriously responsible for contact allergy when used in permanent hair dyes, affecting both hairdressers and subjects dyeing their hair. Moreover, although the quantity of PPD in hair dyes is regulated by EU directives, that stipulate a maximum concentration of 6% in the finished product,⁽¹²⁾ there are no laws defining the maximum quantity of PPD permissible in tattoos.⁽¹³⁾ The quote of PPD added to the henna to henna tattoo may be very high in order to obtain a darker tattoo who persist longer to the skin. Liquid chromatography, performed on many samples of tinctures used for temporary tattoos found to cause allergic reactions, has demonstrated that the PPD concentration may be far higher than this value permitted in hair dyes,^(14,15) and may well induce active sensitization.⁽⁶⁾

Other substances with a potential sensitizing action, such as thiurams, accelerants used in rubber vulcanization processes^(16–18) and latex cross-reactive proteins,⁽¹⁹⁾ may be present as contaminants in tattoo inks and induce contact allergy. In some cases, reported in literature it is hypothesized that PPD may act as an adjuvant, increasing the sensitization to the above contaminants.⁽²⁰⁾ Finally, chromatography has shown that henna tattoos can also contain heavy metals, such as nickel, cobalt,⁽²¹⁾ and mercury.^(22,23)

Clinical aspects

Contact dermatitis due to tattoos can have an acute onset a few hours after application, but more frequently manifests after some days (generally as many as 15–20), when the subject has returned from the holiday and the tattoo has faded or disappeared. Exceptional cases of onset of allergic contact dermatitis have been reported as late as 30–45 days after application of the tattoo. In cases of pre-existing sensitization to PPD (provoked by permanent hair dyes or cosmetics),^(24,25) or in cases of contact allergy to substances of the *para* group that cross-react with PPD (sulfamides, local anaesthetics, azoic dyes),^(26,27) the period of latency of the dermatitis is shorter. According to some authors, the method of execution of the tattoo also affects the latency time: occlusion of the tattoo, done to speed the drying process, favors absorption of the dye and accelerates the sensitization process.⁽²⁸⁾ The habit of retouching the tattoo as soon as it starts to fade can also favor the development of an allergic reaction due to re-exposure to the allergen.⁽²⁸⁾

Execution of a tattoo may induce sensitization to PPD without clinical manifestations which can develop after the contact with PPD from other sources, such as hair dyes.^(3,29–33)

From the clinical-morphological standpoint, contact dermatitis from tattoos generally presents with

a picture of acute eczema that follow the outline of the original tattoo⁽³⁴⁾ and appear strictly localized to the area.^(35,36) The dermatitis can sometimes have a lichenoid appearance.^(4,24,37,38) In literature some cases of dermatitis with an erythematous-polymorphic,^(23,39,40) vesicobullous,^(41,42) or erythematous-edematous^(43,44) appearance have been described. In rare cases, the dermatitis can be associated with systemic symptoms⁽⁴⁵⁾ or present with angioedematous manifestations.⁽⁴⁶⁾ In these cases, it is important to ascertain the immunological mechanism underlying the urticarioid eruption, because PPD can induce IgE-mediated reactions.⁽⁴⁶⁾ In rare cases, PPD used in tattoos can induce a severe picture of intoxication characterized by angioedema of the face and acute renal failure.⁽⁴⁷⁾

Outcome and complications

The most frequent complication of contact dermatitis to henna tattoos is postinflammatory dyschromic changes; this generally disappears after many months but in some cases can become permanent.

In pediatric patients hypopigmentary areas are frequently left at the tattoo site,^(39,48–51) with persistent leukoderma,^(52,53) whereas in adolescents and adults the most common outcome is hyperchromia.^(54,55)

Violent allergic reactions can often leave scars.^(27,56) Some cases of temporary hypertrichosis have also been described at the tattoo site, not necessarily associated with allergic sensitization or inflammatory reactions.^(57,58)

Nevertheless, the potentially most dangerous result is allergic sensitization to PPD and the many substances that might cross-react with this.^(59,60) The spectrum of cross-reactivity of PPD with other para-amino derivatives has been widely studied both *in vivo* (by patch tests),⁽⁶¹⁾ and *in vitro* (by isolating specific T lymphocytes).⁽⁶²⁾ All these studies have confirmed that *para*-amino phenol, *para*-toluendiamine, diaminodiphenylmethane and *p*-amino benzene are all substances that can cross-react with PPD. Many azoic dyes for synthetic fabrics have the same pronounced cross-reactivity;⁽⁶³⁾ among these disperse orange three frequently cross-reacts with PPD.⁽⁶⁴⁾ Subjects sensitized to the PPD contained in henna tattoos can develop contact dermatitis to other textile dyes, such as disperse orange 1, dispersed yellow 3, dispersed red 1 and 17, and direct orange 34 (a direct dye).^(65–68) Recently, a possible cross-reactivity between PPD and lactone sesquiterpenes⁽⁶⁹⁾ and between PPD and the solvents contained in marker pens has been hypothesized.⁽⁷⁰⁾ Moreover, subjects with contact allergy to PPD must avoid taking cross-reacting drugs such as sulfamides, thiazide diuretics and mesalazine, due to the risk of onset of systemic contact dermatitis.^(71,72) Finally, they must also avoid drugs containing disperse yellow-orange sunset (F&DC6, CI 15985), an azoic dye

used by food and pharmaceutical industries, because of the cross-reactivity between PPD and sulfanilic acid (4-aminobenzene sulfonic acid), a metabolite of this dye.⁽⁷³⁾

Conclusions

Contrary to popular belief, henna tattoos should not be regarded as innocuous and risk-free. To avoid the above-described negative consequences of temporary tattoos, considered as a harmless vanity and moment of fun during an exotic holiday, it would be desirable for both scientific associations and individual specialists in dermatology, allergology and paediatrics to set up a massive preventive campaign warning of the risks and dissuading young travellers from indulging in such practices while abroad.⁽⁷⁴⁾

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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