



Temporary henna tattoos

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Abstract Today, temporary henna tattoos drawn on the skin are very fashionable and have become more and more popular. At the same time, allergic reactions following these tattoos has increased worldwide. Actually, henna has a very low allergic potential. In most cases, allergic reactions are caused by the mixtures used by the so-called “artists” which contain not only natural henna but also many chemical coloring agents such as diaminotoluenes and diaminobenzenes. The long duration of skin contact, the high concentrations of sensitizing materials, and the lack of a neutralizing agent dramatically increases the risk of skin sensitization. We summarized 31 of our own cases with allergic contact dermatitis due to temporary henna tattoos and outlined the main characteristics for this peculiar contact dermatitis.

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Introduction

Henna (*Lawsonia inermis*) is part of the family Lythraceae, which is best known as a source of natural dyes. Carl Linnaeus, the famous Swedish botanist, gave it the name of his assistant, the Scottish physician, Isaac Lawson. *Inermis* is Latin for “unarmed;” when henna is cultivated, it loses its thorns.¹ Henna is a deciduous, 2- to 6-m high shrub with acuminate leaves (Fig. 1). The flowers are yellowish white to brick red, and the fruit is a dry berry. The seeds are blue-black, angular, and small. The active ingredient of henna is lawsone (2-hydroxy-1,4-naphthoquinone).

Henna in antiquity

In ancient times, henna was recommended as a remedy. The plant was used as a medicine both internally and externally for

jaundice, leprosy, smallpox, and skin complaints. Henna leaves were prescribed for thrush, as a poultice for carbuncles, flatulence, and burns. The ancient Egyptians are said to have used oil extracted from the flowers to keep their limbs supple. The writers of the Ebers papyrus commented on this remedy: “Look to it because this is the true remedy.” It was found among the proven remedies in the temple of the God Osiris. It is a remedy that drives away the scurf in every limb of a person. “Yes, it heals at once. You see.” In the Ebers papyrus, henna was called *Kupros*, or *Cyperus*. There are 7 types of henna, including “henna from the north,” “henna from the fields,” “henna from the meadow,” and “henna from the marshes.” Henna may differ when harvested from locations with different soil and moisture levels. Soil and moisture affect henna’s lawsone levels. “Knots of henna,” “thorns of henna,” and “henna grass” are parts of the plant specific to age and growth cycle, which again have different characteristics. Moist, fertile, cool conditions produce low lawsone levels. Dry, hot, iron-bearing soils produce high lawsone levels.

There is evidence that henna was used by the neolithic people in Catal Huyuk, in the seventh millennium BCE to

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Fig. 1 Henna scrub.

ornament their hands in connection with their fertility goddess. The powdered leaves have been used in the Orient for centuries to dye the hair, nails, and skin. According to some papyrus scrolls, henna was used in ancient Egypt to dye the nails and hairs of mummies.

Later uses

The coloring quality of the plant has been used by Muslims from the earliest days of Islam because the prophet Mohamed colored his hair and beard with henna. In Persian art, miniatures dating from between the 13th and 15th centuries pictured dancers taking part in wedding processions in which they were depicted with henna decorations.² In the 12th century, the Moguls transported the plant from Persia to India. There, henna grew popular because of Rajputs of Mevar, who mixed it with aromatic oils and applied it to the hands and feet to beatify those.² Since 1890, henna has been used also in Europe for dyeing hair.¹

Decorating one's hands and feet with henna is a traditional custom for events such as wedding parties and public celebrations in the Middle East.³ The dried leaves are ground into a fine powder and mixed with water or oil to create a paste. The paste is applied directly to the skin with a cone-shaped, soft container and left to dry for 20 to 30 minutes. These temporary henna tattoos (THTs) are called *mehndi* and remain visible for 2 to 4 weeks. Mehndi are used as a reminder of happiness, as a form of blessing for the wearer, and depending on its intent, are used for its aphrodisiac quality.¹

More recent uses and allergic responses

Recently, temporary henna tattoos have become increasingly popular, but this has been accompanied by more allergic reactions. Actually, henna has a very low allergic potential.⁴

There are only a few reports concerning allergic reactions due to pure henna.⁵⁻⁸ Angioneurotic edema on the face, lips, pharynx, and larynx have been observed within a few hours after topical application of henna. Usually, sensitization to henna is an occupational hazard for hairdressers.⁹ The main event of sensitization is inhalation of henna powder dispersed in the air. Patients with asthma after exposure to henna have had both respiratory problems and abnormal pigmentation of the nails.¹⁰

It is of paramount importance that the structure and redox potential of lawsone is similar to 1,4-naphthoquinone, a metabolite of naphthalene and a potent oxidant of glucose-6-phosphate dehydrogenase-deficient cells. Unexplained hyperbilirubinemia observed in infants exposed to henna led to the in vitro demonstration in which it was shown that lawsone is capable of causing oxidative hemolysis. Therefore, the application of temporary henna tattoos should be discouraged in infants in general and in known glucose-6-phosphate dehydrogenase-deficient individuals of any age in particular.¹¹

Emergence of allergic contact dermatitis after henna application indicates the presence of a skin sensitizer. Although it is astonishing how henna, used since ancient times for decoration, can induce so many cases of allergic contact dermatitis. The mixtures used by the "artists" for creation of THT give an explanation. The painting with pure henna gives a red color. The blend for temporary tattoos contains natural henna and different coloring agents, which darken the color. There are different types of ingredients added to produce the varieties of colors labeled as "black henna" and "blue henna."¹² These include *para*-phenylenediamine (PPD), coffee or black tea, lemon juice, eucalyptus, clove, or mustard oil. Other options are fenugreek seeds and/or okra and tamarind paste for a smoother texture. In some parts of the world, fresh urine of animals such as camels and

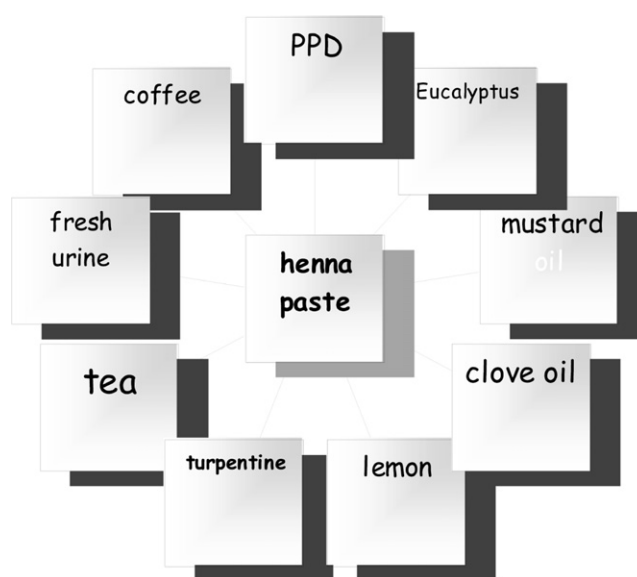


Fig. 2 Possible ingredients in the henna paste.



Fig. 3 Positive patch test for PPD.

yaks is added to the henna to help create a dark color. All ingredients within the henna paste could be a determining factor for allergic skin reaction (Fig. 2). In most cases, they contain chemical coloring agents such as diaminotoluenes and diaminobenzenes.

Clinical experience

We have summarized 31 of our own cases with allergic reactions due to THTs and have tried to outline the main characteristics for this special kind of allergic contact dermatitis. We have delineated the characteristic features, concerning etiology, the incubation period, clinical picture, and the complications of the allergic contact dermatitis due to THT.

Etiology

Patch testing usually shows a strongly positive response to PPD. In our study, patch testing showed 87% positive

reactions to PPD (Fig. 3), 6% to henna mix, and 7% showed negative result. There were no positive reactions to the natural henna.

Diaminobenzenes and particularly PPD are components of dark and permanent hair dyes. *para*-Phenylenediamine, also called 1,4-diaminobenzene, is a low-toxicity diamine used in almost every hair dye on the market, regardless of brand—the darker the color, usually the higher the concentrations. Even the so-called natural and herbal hair colors, although ammonia-free, contain PPD. Being incredibly cheap, this product is added to the henna paste to speed up the process (to minutes) and intensify the color of the dye.¹³ Mass spectrometry analysis of commercial black henna for molecular weight revealed a major peak at the mass/charge ratio of 108.1, which corresponds to the molecular weight of PPD.¹⁴

para-Phenylenediamine is a known skin and respiratory tract sensitizer. It can induce allergy per se or be a marker of an allergy to other diaminobenzenes present in the black henna mixture.¹⁵ The mechanism of sensitization is based on the conversion (by oxidation) of the prohaptens (PPD) to the haptens (quinone diamine) that can react directly with a protein, causing irritation of the skin and mucous membranes of the sensitive individuals. Cross-sensitization to para-allergens may also occur. *para*-Phenylenediamine cross-reacts with related compounds that have an amino group in the para-position of the benzene ring. Examples include *para*-amino benzoic acid, sulfonamides, sulfonylureas, dapsone, azo dyes, and benzocaine.¹⁶

Incubation period

Generally accepted induction of allergic contact dermatitis can take as long as 7 to 20 days. If a patient has had previous exposure to PPD such as that found in hair dyes or to cross-reacting substances, induction times can be as short as 24 to 48 hours.¹⁶ Surprisingly, we stumbled upon a very short incubation period of 4 to 7 days in our study. The same observation was reported by Wolf et al.¹⁷ What are the possible explanations?



Fig. 4 Allergic contact dermatitis after THT.



Fig. 5 Hyperpigmentation in the form of yin-yang.

Patients have already been sensitized to PPD

All patients were school-aged; therefore, the short incubation was not due to occupational exposure or history of dyed hair¹⁷ (only 1 patient from our study had been coloring his hair). So we shared the view of Wolf and coauthors that this hypothesis would appear to be incorrect.

para-Phenylenediamine has high potency as sensitizer

para-Phenylenediamine was found to be present in the black henna tattoo mixture at a concentration of 15.7%. This concentration is significantly higher than in commercial hair dye preparations.¹⁸ The long duration of skin contact, the high concentrations of sensitizing materials, and the lack of a neutralizing agent dramatically increase the risk of skin sensitization.¹⁸ The use of PPD and other diaminobenzenes is allowed in the EU for hair dyes in maximum concentration of 6% free base in the final product and 10% diaminotoluenes. The same directive forbids the use of PPD for dyeing eyelashes, eyebrows, or skin.³

Special technique of applying the mixture

Henna artists use a syringe more than any other tool. The needle penetrate stratum corneum; this way the antigen is directly served to the Langerhans cells and there is no time lost in penetrating the upper layer of the skin. Also, occlusive dressing (many sorts of seals—every henna artist has a favorite, several sorts of wrap, gloves, socks, first aid nonirritating paper tape bandage) used as something to keep the henna stuck on the skin enhance the penetration and could speed up the process.

Clinical picture

In our study, 82% of the patients have the typical clinical picture of acute allergic contact dermatitis (Fig. 4). In 18% of the cases, the clinical findings have the characteristics of lichenoid contact dermatitis. Another important observation was the long-lasting hyper- or hypopigmentation (in 86% of the cases, more than 6 months). We documented hyperpigmentation in 10 patients (Fig. 5) and hypopigmentary changes in 21 patients. We could not say if this is a prolonged postinflammatory reaction, or in the cases of hypopigmentation, the henna dye is acting as a sunblock agent.

Complications

para-Phenylenediamine cross-reacts with related compounds that have an amino group in the para-position of the benzene ring. People with known reactions to PPD or cross-reacting allergens such as sulfonamides, *para*-amino benzoic acid, sulfonylureas, dapsone, azo dyes, or benzocaine should

be especially cautious of black henna tattoo application. Practitioners should be aware of sensitization to henna and of possible allergic reactions, especially after hair coloring with dyes based on PPD.¹⁶

Since 1997, an increasing number of articles have appeared concerning sensitization to PPD-henna mixtures.^{19,20} More than 100 cases of contact dermatitis due to henna mixed with PPD and other additives have been reported.^{12,21} In all cases, PPD was confirmed to be the key factor for the development of allergic contact dermatitis. Reactions to PPD found in temporary tattoos are primarily type IV delayed-type hypersensitivity presenting as allergic contact dermatitis, lichenoid reactions,^{22,23} and even erythema multiforme.²⁴ Type I reactions have also been shown to occur, presenting as angioedema.²⁵ With the increasing of temporary tattoos, future cases of sensitization to PPD are expected. Allergic contact reactions from THT carry high risk of prolonged postinflammatory hyper- or hypopigmentation, especially for skin type III and IV.^{4,26} Furthermore, the use of henna should be discouraged in infants in general, and in known glucose-6-phosphate dehydrogenase-deficient individuals of any age, because of the hemolytic capability of lawsone.¹⁰ Before using hair dye, it is important to find out whether a THT was ever applied and whether this tattoo resulted in a rash a few days later. One would then expect a severe reaction to the hair dye subsequently used.² According to our opinion, THT is hazardous for one's health.

References

1. Van Braak H. Natürliches Henna. Niedernhausen: Falken Verlag; 2001. p. 10-7.
2. Raboobee F. Sensitisation from PPD in temporary henna tattoos and subsequent severe allergic contact dermatitis from hair dye. *Curr Allergy Clin Immunol* 2004;17:195.
3. Le Coz CJ. Allergic contact dermatitis caused by skin painting (pseudotattooing) with black henna, a mixture of henna and *p*-phenylenediamine and its derivatives. *Arch Dermatol* 2000;136:1515-7.
4. Wohrl S, Hemmer W, Focke M, Gotz M, Jarisch R. Hypopigmentation after non-permanent henna tattoo. *J Eur Acad Dermatol Venereol* 2001; 15:470-2.
5. Carsia Ortiz JC, Terron M, Bellido J. Contact allergy to henna. *Int Arch Allergy Immunol* 1997;114:298-9.
6. Wantke F, Gotz M, Jarisch R. Contact dermatitis due to henna, solvent red 1 and solvent red 3. A case report. *Contact Dermatitis* 1992;27: 346-7.
7. Nigam PK, Saxena AK. Allergic contact dermatitis from henna. *Contact Dermatitis* 1988;18:55-6.
8. Gupta BN, Mathur AK, Agarwal C, Singh A. Contact sensitivity to henna. *Contact Dermatitis* 1986;15:303-4.
9. Bolhaar STHP, Mulder M, van Ginkel CJW. Occupational allergy in a hairdresser. *Allergy* 2001;56:248.
10. Starr JC, Yuringer J, Brasher GW. Immediate type I asthmatic response to henna following occupational exposure in hairdresser. *Ann Allergy* 1982;48:98-9.
11. Raupp P, Hassan JA, Varughese M, Kristiansson B. Henna causes life threatening haemolysis in glucose-6-phosphate dehydrogenase deficiency. *Arch Dis Child* 2001;85:411-2.

12. Lestringant GG, Bener A, Frossard PM. Cutaneous reaction to henna and associated additives. *Br J Dermatol* 1999;141:598-600.
13. Onder M, Atahan CA, Oztas P, Oztas MO. Temporary henna tattoo reactions in children. *Int J Dermatol* 2001;40:577-9.
14. Chung WH, Chang YC, Yang LJ, et al. Clinicopathologic features of skin reactions to temporary tattoos and analysis of possible causes. *Arch Dermatol* 2002;138:88-92.
15. Pegas JR, Criad PR, Criado RF, Vasconcellos C, Pires MC. Allergic contact dermatitis to temporary tattoo by *p*-phenylenediamine. *J Investig Allergol Clin Immunol* 2002;12:62-4.
16. Arroyo M. Black henna tattoo reaction in a person with sulfonamide and benzocaine drug allergies. *J Am Acad Dermatol* 2003;48.
17. Wolf R, Wolf D, Matz H, Orion E. Cutaneous reactions to temporary tattoo. *Derm Onlin J* 2003;9,3.
18. Brancaccio RR, Brown LH, Chang YT, Fogelman JP, Mafong EA, Cohen DE. Identification and quantification of *para*-phenylenediamine in a temporary black henna tattoo. *Am J Contact Dermat* 2002;13:15-8.
19. Hausen BM, Stephan U, Heidbreder G. A summer holiday souvenir: *p*-phenylene diamine contact hypersensitivity. *Akt Derm* 2000;26: 230-4.
20. Wakelin SH, Creamer D, Rycroft RJG, White IR, McFadden JP. Contact dermatitis from para-phenylene diamine used as skin paint. *Contact Dermatitis* 1999;38:92-3.
21. Gallo R, Ghigliotti G, Cozzani E, Balestrero S. Contact dermatitis from para-phenylene diamine used as a skin paint: a further case. *Contact Dermatitis* 2000;40:57.
22. Rubegni P, Fimiani M, de Aloe G, Andreassi L. Lichenoid reaction to temporary tattoo. *Contact Dermatitis* 2000;42:117-8.
23. Schultz E, Mahler V. Prolonged lichenoid reaction and cross-sensitivity to para-substituted amino-compounds due to temporary henna tattoo. *Int J Dermatol* 2002;41:301-3.
24. Jappe U, Hausen BM, Petzoldt D. Erythema-multiforme-like eruption and depigmentation following allergic contact dermatitis from a paint-on henna tattoo, due to *para*-phenylenediamine contact hypersensitivity. *Contact Dermatitis* 2001;45:249-50.
25. Abdulla K, Davidson N. A woman who collapsed after painting her soles. *Lancet* 1996;348:658.
26. Chung WH, Wang CM, Hong HS. Allergic contact dermatitis to temporary tattoos with positive *para*-phenylenediamine reactions: report of four cases. *Int J Dermatol* 2001;40:754.