Cureus

Open Access Case Report

DOI: 10.7759/cureus.36697

Erythematous Linear Lesion on the Course of Superficial Fibular Nerve After the Topical Application of Black Henna: A Case Report

Review began 03/13/2023
Review ended 03/17/2023
Published 03/26/2023

© Copyright 2023
Alkandari et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Ahmed F. Alkandari [1, 2] , Abrar A. Alawadhi [2] , Fatma A. Alawadhi [2] , Alyaa Mousa [1] , Sampath Madhyastha [1]

1. Department of Anatomy, Kuwait University, Jabriya, KWT 2. Department of Surgery, Al-Adan Hospital, Al-Ahmadi, KWT

Corresponding author: Sampath Madhyastha, madhyast@yahoo.com

Abstract

Henna is commonly used in body arts, where it produces orange-brown color. It is often mixed with chemicals such as para-phenylenediamine (PPD) to fasten the dyeing process and produce a black color. However, PPD has many allergic and toxic effects. We present a case of henna-induced cutaneous neuritis, which is not reported before. A 27-year-old female presented to our hospital, complaining of pain in her left great toe after applying black henna. Upon examination, the proximal nail fold was inflamed, and an erythematous non-palpable tender lesion was noticed on the dorsum of the foot. The lesion had an inverted-Y shape that was confined to the course of the superficial fibular nerve. Cutaneous nerve inflammation was favored after excluding all the anatomical structures in the region. Black henna should be avoided since it contains PPD, which can be absorbed through the skin and affect the underlying cutaneous nerves.

Categories: Neurology, Allergy/Immunology, Anatomy
Keywords: cutaneous neuritis , superficial fibular nerve, ppd, para phenylenediamine, black henna

Introduction

The application of topical cosmetics over the skin as temporary body art is common in many parts of the world, including the Arabian Gulf [1]. Henna or Hina, a dried leaf of the Lawsonia Inermis plant (family Lythraceae), is used to dye the skin of palms, dorsum of the hand, soles, dorsum of the feet, hair, and nails [2]. Henna has been used to beautify women's bodies during wedding ceremonies and other social celebrations in Arab countries and India. However, some individuals may develop allergic reactions to henna, which is safer than black henna. Adding chemicals to henna makes it toxic and fatal [3]. Paraphenylenediamine (PPD) is the commonly used ingredient in most hair dye preparations, including commercially available henna, where its concentration may reach up to 30% [4], despite the regulations to restrict it to 6% [5]. Furthermore, the level of PPD in black henna used for tattooing is higher than that found in hair dyes [6].

The terms 'Kala Pathar' and 'paraphenylenediamine' are interchangeably used in literature. Kala Pathar, meaning 'black rock' in Nepali, is a mountain in the Nepalese Himalayas [7], from which the PPD is extracted as its most active ingredient [6]. PPD is an aromatic amine derived from para-nitroaniline that belongs to oxidizing dyes [8]. The pure form of PPD is white to yellow in color, which darkens on exposure to air via oxidation [6]. The easy availability and low cost of PPD-containing henna make it a widely used substance and a preferred agent for suicidal and homicidal intents [9, 10]. In Kuwait, PPD-containing henna is available in two forms; a powder and a paste. While the paste form of henna can be applied directly on the skin, the powder form is mixed with water before its application.

PPD is mainly used as an element of oxidative hair coloring products and temporary tattoos to fasten the dyeing process and produce a black color [11-13]. It can penetrate the hair shaft and undergo oxidative reactions, causing hair discoloration [14]. PPD is also known to be used in tissue preparation for histological studies on nerves [15]. It can enhance osmium staining of myelin sheaths of peripheral nerves by chelating the osmium in tissues fixed with osmium tetroxide [16].

The systemic and local side effects of oral ingestion of PPD-containing hair dyes are explained in the Discussion section. Motor neuropathy after ingesting black henna is rarely reported [17]. Topical cosmetics penetrate the intact skin by trans-epidermal or trans-appendageal route [18, 19]. The damaged skin can allow substances to penetrate easily [20], as per acute eponychia. Acute eponychia, an inflammation of the proximal nail fold, is caused by a minor trauma that disrupts the protective barrier between the nail fold and plate, leaving it vulnerable to bacterial invasion and infection [21]. Reports of allergic contact dermatitis to natural henna are very rare in the literature, and often assumed that natural henna is a very weak skin allergen [22]. We, therefore, present a case of cutaneous nerve inflammation after the topical application of PPD-containing henna facilitated by a defect in the skin barrier.

How to cite this article
Alkandari A F, Alawadhi A A, Alawadhi F A, et al. (March 26, 2023) Erythematous Linear Lesion on the Course of Superficial Fibular Nerve After the Topical Application of Black Henna: A Case Report. Cureus 15(3): e36697. DOI 10.7759/cureus.36697

This study was previously presented as a poster and published as a meeting abstract at the 25th Health Sciences Center (HSC) Conference during March 16-18, 2021.

Case Presentation

A 27-year-old woman with no past medical history presented to the casualty operation theater at Al-Adan hospital, complaining of pain in her left great toe for the past day. History taking revealed no recent trauma to the affected foot. Upon examination, the proximal nail fold of the left great toe was inflamed (eponychia). The nail plate showed normal morphology, but the proximal nail folds of the toes had blackish macules, which upon asking, they were remnants of black henna applied about 15 days before. Coincidentally, an erythematous non-palpable tender lesion was found on the dorsum of the affected foot. The lesion had the shape of an inverted 'Y,' which ran along the course of the superficial fibular peroneal nerve, as shown in Figure *1*.

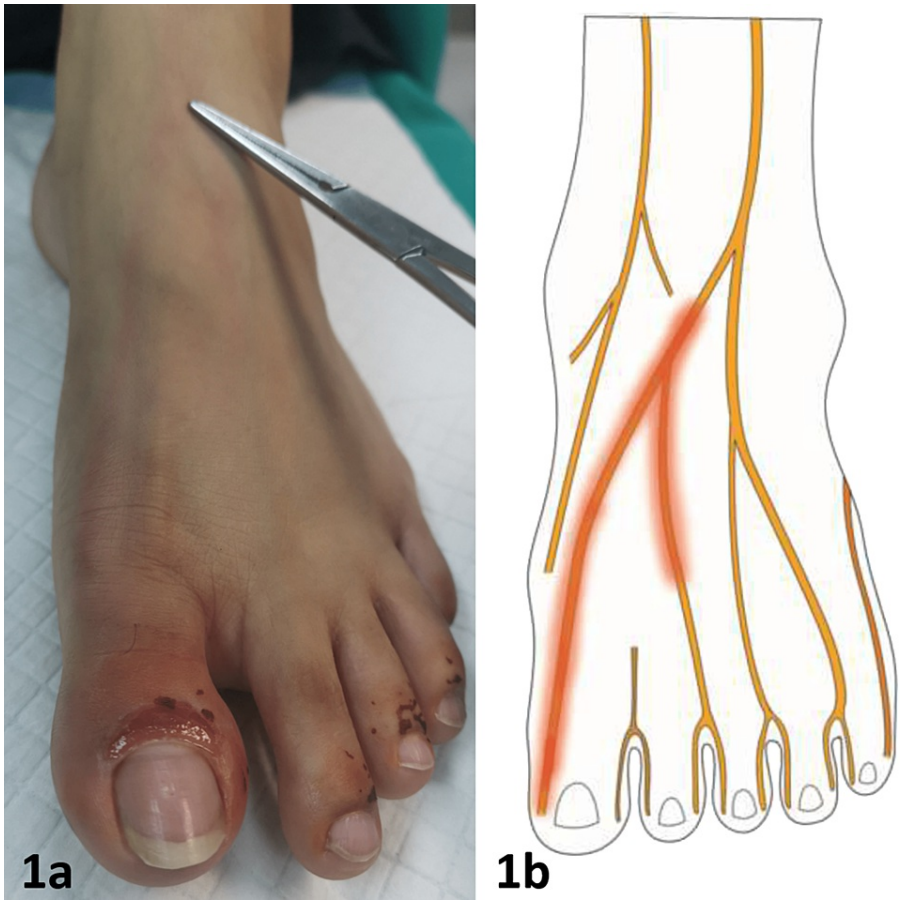


FIGURE 1: Clinical and anatomical correlation.

(a) Dorsum of the patient's left foot: showing the inverted 'Y' lesion running along the course of the superficial fibular nerve. (b) Sensory innervation of the dorsum of the foot showing the affected branches of the nerve (Courtesy of Sampath Madhyastha, the corresponding author).

The patient denied any history of trauma to the nail. The patient also denied any history of allergy in the form of atopic dermatitis. A general physical examination showed no fever or regional lymphadenopathy. Motor examination showed no muscle weakness or pain upon plantar flexion. Sensory examination showed no paresthesia, hyperesthesia, or burning sensation. However, the patient experienced an electrical touch while pinching the skin over the course of the affected nerve. The eponychia was deroofed, the fluid was drained, and the patient was discharged with oral antibiotics and painkillers.

Discussion

The systemic and local side effects of oral ingestion of PPD-containing hair dyes are listed in Table *1*.

Onset of symptoms	
Early symptoms (due to hypersensitivity and anaphylactic reaction)	Purple discoloration of teeth or gums. Contact dermatitis and blepharoconjunctivitis. Epigastric pain and vomiting. Angioneurotic edema and respiratory distress. Muscular cramps and convulsions. Anaphylactic shock.
Late symptoms (due to toxic effects on various body systems)	Heart: acute myocarditis, myocardial infarction, and cardiac arrest. Muscles: skeletal muscle fatigue, limb rigidity, and rhabdomyolysis. Kidneys: acute tubular necrosis and acute renal failure. Liver: acute hepatitis and acute hepatic failure. Central nervous system: drowsiness, lethargy, seizure, coma, critical illness neuropathy, pure motor paralysis, syndrome of hypertonia and hyperreflexia, and optic neuritis.

TABLE 1: Systemic and local side effects of ingestion of PPD-containing hair dye.

PPD: Paraphenylenediamine.

To the authors' best knowledge, this is the first documented case of cutaneous nerve inflammation after the topical application of henna in humans. Black henna contains PPD [6], which can be absorbed through the skin [23]. Damaged skin, in turn, can facilitate the absorption of topical cosmetics [20]. In our case, the erythematous Y-shaped lesion observed along the course of the superficial fibular nerve was induced by PPD found in black henna, which was applied 15 days ago. The defect in the skin barrier, in terms of eponychia, facilitated the absorption and diffusion of PPD into the skin and underlying nervous tissue. The mechanism by which PPD affects the nervous tissue could be due to two presumptions: neuro-receptor damage or myelin sheath damage. In neuro-receptor damage, the hypothesis is based on the idea that the 'non-encapsulated' free nerve endings are vulnerable to mechanical and chemical damage from the environment [24]. While in myelin sheath damage, it is based on the affinity of PPD to affect and stain phospholipids as it does in the histological preparations for nervous tissues [15]. Waggas A and Arabia S [1], in their animal study, found that the topical application of PPD (2 mg/kg) on the fur of brown rats for five weeks can cause a significant decrease in the content of monoamines in all brain regions, causing various CNS symptoms such as ataxia and seizures. Infectious or mechanical tenosynovitis of the extensor tendons, thromboangiitis obliterans, and superficial lymphangitis was ruled out in this patient. Kano Y et al. [25] reported a linear lesion caused by superficial lymphangitis after the onset of paronychia in the thumb, possibly due to bacterial infection. However, in our case, the lesion was not palpable and did not cause regional lymph node enlargement, which excludes superficial lymphangitis. Nevertheless, a final diagnosis could not be made with certainty since a skin biopsy was not done. Cutaneous nerve inflammation was favored after excluding the other anatomical structures in the region and because of the electrical touch experienced by the patient while pinching the skin over the course of the affected nerve. The limitation of this report includes a culture and sensitivity test for pus would confirm the diagnosis of eponychia. Also, a patch skin test for PPD could exclude contact allergy. Skin biopsy for the lesion could confirm the diagnosis of cutaneous neuritis.

Conclusions

Using black henna should be avoided since it contains PPD, which can be absorbed through the skin and affect the underlying nervous tissue. Further studies will be useful to consider PPD as a neuro-inflammatory agent in producing peripheral nerve inflammation while designing research study designs.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Waggas A, Arabia S: Neuro and nephro-toxicity in rats topically treated with para-phenylene diamine . Am Eurasian J Toxicol Sci. 2011, 3:130-137.
2. de Groot AC: Side-effects of henna and semi-permanent 'black henna' tattoos: a full review . Contact Dermatitis. 2013, 69:1-25. 10.1111/cod.12074

3. Balasubramanian D, Subramanian S, Thangaraju P, Shanmugam K: Right bundle branch block: an uncommon cardiotoxic manifestation of hair dye poisoning-a case report. J Clin Diagn Res. 2014, 8:174-176. 10.7860/JCDR/2014/6966.3962
4. Ibrahim SY, Fawzi MM, Saad MG, et al.: Determination of heavy metals and other toxic ingredients in henna (Lawsonia inermis). J Environ Anal Toxicol. 2016, 6:364. 10.4172/2161-0525.1000364
5. Kim KH, Kabir E, Jahan SA: The use of personal hair dye and its implications for human health . Environ Int. 2016, 89-90:222-227. 10.1016/j.envint.2016.01.018
6. Al-Suwaidi A, Ahmed H: Determination of para-phenylenediamine (PPD) in henna in the United Arab Emirates. Int J Environ Res Public Health. 2010, 7:1681-1693. 10.3390/ijerph7041681
7. Stevens S: Tourism and deforestation in the Mt Everest region of Nepal . Geogr J. 2003, 169:255-277.
8. Chugh KS, Malik GH, Singhal PC: Acute renal failure following paraphenylene diamine (hair dye) poisoning: report of two cases. J Urol. 1982, 128:1423. 10.1016/S0022-5347(17)53564-8
9. Bhagavathula AS, Bandari DK, Khan M, Shehab A: A systematic review and meta-analysis of the prevalence and complications of paraphenylenediamine-containing hair dye poisoning in developing countries. Indian J Pharmacol. 2019, 51:302-315. 10.4103/ijp.IJP_246_17
10. Khaskheli MS, Shaikh S, Meraj M, et al.: Paraphenylenediamine poisoning: clinical features, complications and outcome in a tertiary care institute. Anaesth Pain Intensive Care. 2018, 22:343-347.
11. Ishaque S, Ul Haq A, Jurair H, Siyal H: Kaala pathar (paraphenylene diamine) poisoning and angioedema in a child: an unusual encounter. J Clin Toxicol. 2016, 6: 10.4172/2161-0495.1000294
12. Diepgen TL, Naldi L, Bruze M, et al.: Prevalence of contact allergy to p-phenylenediamine in the European general population. J Invest Dermatol. 2016, 136:409-415. 10.1016/j.jid.2015.10.064
13. Saad H, Mousa HM, Ali BH: Some toxicological observations on phenylenediamine (hair dye) in rats and chickens. Pak J Biol Sci. 2000, 3:953-956. 10.3923/pjbs.2000.953.956
14. Hooff GP, van Huizen NA, Meesters RJ, et al.: Analytical investigations of toxic p-phenylenediamine (PPD) levels in clinical urine samples with special focus on MALDI-MS/MS. PLoS One. 2011, 6:e22191. 10.1371/journal.pone.0022191
15. Weis J, Brandner S, Lammens M, Sommer C, Vallat JM: Processing of nerve biopsies: a practical guide for neuropathologists. Clin Neuropathol. 2012, 31:7-23. 10.5414/np300468
16. Ledingham JM, Simpson FO: The use of p-phenylenediamine in the block to enhance osmium staining for electron microscopy. Stain Technol. 1972, 47:239-243. 10.3109/10520297209116543
17. Punjani NS: Paraphenylene diamine (hair dye) poisoning leading to critical illness neuropathy . J Neurol Disord. 2014, 2:5. 10.4172/2329-6895.1000180
18. Schuetz YB, Naik A, Guy RH, Kalia YN: Emerging strategies for the transdermal delivery of peptide and protein drugs. Expert Opin Drug Deliv. 2005, 2:533-548. 10.1517/17425247.2.3.533
19. Shahzad Y, Louw R, Gerber M, du Plessis J: Breaching the skin barrier through temperature modulations . J Control Release. 2015, 202:1-13. 10.1016/j.jconrel.2015.01.019
20. Gattu S, Maibach HI: Enhanced absorption through damaged skin: an overview of the in vitro human model . Skin Pharmacol Physiol. 2010, 23:171-176. 10.1159/000288163
21. Rerucha CM, Ewing JT, Oppenlander KE, Cowan WC: Acute hand infections . Am Fam Physician. 2019, 99:228-236.
22. Pasricha JS, Gupta R, Panjwani S: Contact dermatitis to henna (Lawsonia) . Contact Dermatitis. 1980, 6:288-289. 10.1111/j.1600-0536.1980.tb04936.x
23. Steiling W, Kreutz J, Hofer H: Percutaneous penetration/dermal absorption of hair dyes in vitro . Toxicol In Vitro. 2001, 15:565-570. 10.1016/s0887-2333(01)00062-5
24. Malinovský L: Mechanoreceptors and free nerve endings . Biology of the Integument. Bereiter-Hahn J, Matoltsy AG, Richards KS (ed): Springer, Berlin, Heidelberg; 1986. 10.1007/978-3-662-00989-5_27
25. Kano Y, Inaoka M, Shiohara T: Superficial lymphangitis with interface dermatitis occurring shortly after a minor injury: possible involvement of a bacterial infection and contact allergens. Dermatology. 2001, 203:217-220. 10.1159/000051752