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CASE REPORT OPEN ACCESS

Early presentation of allergic contact dermatitis due to paraphenylenediamine

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Abstract
Allergic contact dermatitis (ACD) is a more frequent pathology in adults than in children, because, in most cases, allergic sensitization requires a prolonged exposure time to the allergen, mostly months or years. In fact, the actual incidence and prevalence of ACD in children and adolescents is unknown. However, there is a hypothesis that ACD is increasing in the pediatric population. Among the allergens involved in ACD, the frequency of paraphenylenediamine (PPDA) is increasing. PPDA is one of the five most common contact allergens in the general population and one of the 10 most common contact allergens in children. The most relevant sources today are henna tattoos and hair dyes. Currently, European Union legislation limits the use of PPDA in hair dyes and prohibits its use in henna tattoos. Despite this legislation, the use of henna tattoos with PPDA is becoming more frequent in younger ages. We report an early presentation of ACD by PPDA, with a permanent hypopigmented skin area as an aftermath, in a 7-year-old male child. We believe that health authorities should advise against making these tattoos in children.

[#]This case was reported as an oral presentation at the SCCALP meeting, Segovia, Spain, on April 14, 2023.

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Introduction

Contact dermatitis represents the inflammatory response of the skin to multiple exogenous agents. There are two subtypes of contact dermatitis: allergic contact dermatitis (ACD) and irritant contact dermatitis. Irritant contact dermatitis is due to direct toxic damage of the agent on the skin, without the mediation of an immunological mechanism, while allergic contact dermatitis is due to a Type IV hypersensitivity reaction.[1] Among the most important risk factors of ACD are genetics and atopic dermatitis. Atopic dermatitis is common in genetically predisposed people, because they present a basal alteration of the skin barrier function.[1]

The actual incidence and prevalence of ACD in children and adolescents is largely unknown.[2] However, ACD is responsible for up to 20% of all dermatitis observed in the pediatric population.[2] Sensitization to these allergens in most cases requires a long time, months or even years, which is why it is a more frequent pathology in adulthood than in pediatric population.[1] If we assess sensitization in patients who have undergone patch tests, the prevalence varies between 13 and 24% in asymptomatic patients and 4 and 77% in symptomatic patients.[2] There is a general suspicion that ACD is increasing in the pediatric population.[2]

There is little information about the average age of presentation of ACD. In a study of a series of 726 patients in the Spanish pediatric population, the mean age of presentation of ACD was 10.9 years with a 95% confidence interval (CI) of 10.6–11.2 years.[3]

The most frequently implicated allergen in ACD in the pediatric population is nickel, the main route of sensitization being piercing of the earlobes in children.[1]

Another contact allergen that is gaining relevance is paraphenylenediamine (PPDA). PPDA is one of the 5 most potentially sensitizing contact allergens in the general population[3,4] and one of the 10 most common contact allergens in children.[1] This is due to its ease to penetrate the skin, promoting sensitization.[5] PPDA is found in various products, such as rubber, printing ink, photographic products, and footwear, but the most relevant sources today are henna tattoos and hair dyes.[5] In henna tattoos, PPDA achieves a darker and more durable coloration, increasing the duration of the tattoo from 2 to 6 h to 2 to 6 weeks[5].

The manifestation of allergy to PPDA usually include symptoms of local eczema, and also cases of lichenoid reactions and systemic manifestations such as erythema multiforme. Although the prognosis is usually favorable, cases with necrotic lesions with unsightly healing, keloids and residual hypopigmentation, and cases with vital compromise have been described. [3,6,7]

Currently, the European Union legislation allows the use of PPDA in hair dyes up to a maximum concentration of 2%,[8,9] and prohibits its use in henna tattoos.[3] Despite this legislation, the use of hair dyes and henna tattoos with PPDA is more common in younger ages.[5] It has been observed that the concentrations of PPDA in henna tattoos ranges from 4.28 to 27.24%.[5,10] For this reason, the incidence of ACD due to PPDA is increasing in the general population and especially in children.[5] The prevalence of ACD due to PPDA in the general population is estimated to be around 0–1.5%[5] and in patients undergoing patch tests around 4%.[5] With regard to the pediatric population, in a study of a series of 726 patients of the Spanish pediatric population, the prevalence of ACD due to PPDA was 4.68% in children undergoing patch tests. It was observed that the incidence had doubled in the last 30 years.[3] In this study, the boys-to-girls ratio was 1:1.29 in ACD and 1:1.26 in ACD due to PPDA.[3]

In a revision of the literature by experts, they proposed that well-localized and recurrent eczematous lesions in children should suggest an allergic contact dermatitis, inducing physicians to refer patients for patch testing. Physicians should be acquainted with the current trends and the emerging contact allergens in children, in order to provide not only the best treatment but also the best management and prevention.[11]

Case Report

We report, after obtaining informed consent from guardians or parents, the case of a 7-year-old male patient, with a family and personal history of atopic dermatitis, who has inflammation and skin itching on the left forearm after having a temporary henna tattoo on this skin area. He refers to having the tattoo done in an establishment on the beach 10 days before the onset of symptoms. Physical examination revealed inflammation (papular erythema and vesiculation) limited to the contour of the tattoo (Figure 1). After treatment with methylprednisolone aceponate, there was a progressive reduction in inflammation (Figure 2). Subsequently, all the inflammatory signs decreased until their resolution, and the persistance of visible hypopigmented skin area was observed at 7 and 15 weeks (Figures 3 and 4).

Figure 1. 10 days after tattoo.

Figure 2. 13 days after tattoo.

Figure 3. 7 weeks after tattoo.

We used True-test® patches for the diagnosis. In the patch tests reading, there was only one positive result for paraphenylenediamine, presenting papular erythema at the skin area (Figures 5 and 6). Routine blood count was performed by the general practitioner, and and eosinophil level of 7.7% (524 eosinophils per microliter) was observed. We did not carry out complementary studies due to no suspicion of other allergies.

The allergens are located in three panels. Each panel has two notches to mark with a medical-marking pen (circular areas marked with blue), in order to provide a correct interpretation of the results after removal of the panels.

Figure 4. 15 weeks after tattoo.

Figure 5. Patch tests.

Figure 6. Patch test PPDA.

Discussion

Based on the patch tests carried out, we confirmed a case of ACD due to delayed hypersensitivity reaction.[1] According to the bibliographic review carried out, the actual incidence and prevalence of ACD in children and adolescents is largely unknown.[2] On the other hand, sensitization to these allergens in most cases requires a long time, usually months or even years, which is why it is a more frequent pathology in adulthood than in pediatric population.[1] In addition, there is little information about the average age of the presentation of ACD. In a study of a series of 726 patients in the Spanish pediatric population, the mean age of presentation of ACD was 10.9 years with a 95% CI of 10.6–11.2 years.[3] For this reason, we consider this case report to be exceptional, because it involves a 7-year-old male patient, a much younger age than that reported in the consulted bibliography. In addition, the allergen detected was not nickel, the most frequently observed allergen in children,[1] but PPDA. In the case of our patient, he did not report of any previous contact with the most common sources of sensitization for PPDA, tattoos and dyes.[5] Therefore, although the source of sensitization in our patient is unknown, other possible ways of sensitization that are less frequent could be rubber, printing ink, photographic products, footwear, etc.[5]

Therefore, we report an infrequent case of ACD, in a male under 7 years of age, due to an unusual allergen, the incidence of which is increasing.[1]

On the other hand, although the manifestation in our case has been the most frequent (local inflammation), it has presented permanent residual hypopigmentation, which is also described as an aftermath in the literature.[3,6,7]

Conclusion

We consider it important to report a case of ACD due to an infrequent allergen, although its incidence is increasing, at a very early age and which has caused an unaesthetic aftermath to the patient.

We consider that an increase in health inspections of establishments that perform temporary henna tattoos would be advisable.

We propose that health authorities promote information campaigns for parents and caregivers.

Likewise, we believe that pediatricians, dermatologists, and allergists should advise against making these tattoos, because children's skin is not like that of adults, and temporary henna tattoos are not so temporary.

Moreover, pediatricians should refer patients to allergists for patch testing in view of ACD.

Conflicts of Interest

The authors have no conflicts of interest to declare.

References

1. Valderrama Arnay S, Morales Tirado A, López de Haro de Torres J. Dermatitis por contacto. Protoc Diagn ter Pediatr. 2019; 2:177–84.
2. Castanedo-Tardan MP, Matiz C, Jacob SE. Dermatitis por contacto en Pediatría: Revisión de opiniones actuales. Actas Dermosifiliogr. 2011;102(1) :8–18. https://doi.org/10.1016/j.ad.2009.12.028
3. Ortiz Salvador JM, Esteve Martínez A, Subiabre Ferrer D, Victoria Martínez AM, Cuadra Oyanguren J, Zaragoza Ninet V. Dermatitis alérgica de contacto a parafenilendiamina por tatuajes con henna en población pediátrica. An Pediatr (Barc). 2017;86(3):122–6. https://doi.org/10.1016/j.anpedi.2016.02.010
4. Diego S, Linda L. Paraphenylenediamine in black henna temporary tattoos: 12-year Food and Drug Administration data on incidence, symptoms, and outcomes. J Am Dermatology. 2015;72:724–6. https://doi.org/10.1016/j.jaad.2014.11.031
5. Encabo Durán B, Romero-Pérez D, Silvestre Salvador JF. Actualización en la dermatitis de contacto alérgica por parafenilendiamina. Actas Dermosifiliogr (Engl Ed). 2018;109(7):602–9. https://doi.org/10.1016/j.ad.2017.12.007
6. Sachin S Soni, Amit P Nagarik, Manjunath Dinaker, Gopal Kishan Adikey, Anuradha Raman. Systemic toxicity of paraphenylenediamine. Indian J Med Sci. 2009; 63(4):164–6.
7. Kluger N, Raison-Peyron N, Guillot B. Temporary henna tattoos: Sometimes serious side effect. Press Med. 2008;37(7-8):1138–42. https://doi.org/10.1016/j.lpm.2007.09.021
8. Scientific Committee on Consumer Safety SCCS. The SCCS notes of guidance for the testing of cosmetic ingredients and their safety evaluation 10th revision. The SCCS adopted this guidance document at its plenary meeting on 24–25 October, 2018 [Internet]. [cited 2022 Oct 22]. Available from: https://health.ec.europa.eu/system/files/2019-02/sccs_o_224_0.pdf.
9. Scientific Committee on Consumer Safety SCCS opinion on p-Phenylenediamine colipa n A7 The SCCS adopted this opinion at its 15th plenary meeting of 26–27 June, 2012. [Internet]. [cited 2022 Oct 22]. Available from: https://ec.europa.eu/health/scientific_committees/consumer_safety/docs/sccs_o_094.pdf.
10. Wang PG, Krynitsky AJ. Rapid determination of paraphenylenediamine by gas chromatography-mass spectrometry with selected ion monitoring in henna-containing cosmetic products. J Chromatogr B Analyt Technol Biomed Life Sci. 2011; 879:1795–801. https://doi.org/10.1016/j.jchromb.2011.04.030
11. Belloni Fortina A, Caroppo F, Tadiotto Cicogna G. Allergic contact dermatitis in children. Expert Rev Clin Immunol. 2020;16(6):579–89. https://doi.org/10.1080/1744666X.2020.17778511