Possible role of regional variation in allergic contact dermatitis: case report

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Case Report

A 27-year-old male presented to our dermatitis clinic with 6 months' duration of red oedematous lesions on his ankles. He was previously treated for this suspected allergic contact dermatitis with prednisone (30 mg daily) for 2 weeks, during which time these lesions cleared. However, upon prednisone discontinuation the lesions recurred within several days.

Physical examination showed symmetrical red, oedematous and scaling lesions on the patient's anterior and lateral ankles bilaterally. The dorsa of his feet and his soles were clear, and no psoriatic stigmata were observed. Working diagnoses considered at this point were atypical tinea and possible allergic contact dermatitis. KOH scraping for fungi gave a negative result.

Patch testing was performed with the baseline series of the ICDRG (1). Finn Chambers® were placed on the upper back, and read on day (D) 2 and D4; the ICDRG scoring system was used (maximum of +++). All patch tests gave negative results on D4, except for potassium dichromate 0.5% pet. (++) and cobalt chloride 1% pet. (++). Repeat patch testing was performed with potassium dichromate 2% pet., and gave a positive result (++).

The National Institute for Occupational Safety and Health (NIOSH) was consulted, and samples of the patient's leather footwear were sent to the NIOSH for evaluation of total chromium (Cr) content in the ankle and dorsal foot area. Cr contents of a leather boot were analysed with inductively coupled plasma mass spectrometry (ICP-MS) (NexION 300D; Perkin-Elmer, Waltham, MA, USA) after acid digestion. All glassware was cleaned with 10% (vol/vol) HNO_3 solution, and rinsed with deionized ultrapure water. Five hundred milligrams of each sample was digested with 10 ml of trace metal grade HNO_3, and heated for 4 h at 90°C. Samples were cooled overnight, and non-solubilized residue was allowed to settle. One millilitre of each sample supernatant was diluted to 50 ml with deionized ultrapure water. This solution was used for elemental Cr analysis, performed with an ICP-MS device equipped with a concentric nebulizer, a quartz torch with a quartz injector tube, and a cyclonic spray chamber. All sample quantification was performed with the ^{52}Cr isotope in triplicate against known standards. The leather of the boot at the ankle had a total Cr content of 377 ng/mm^2 (225 mg/kg); the leather at the foot had a total Cr content of 428 ng/mm^2 (268 mg/kg).

The patient's lesions cleared completely when he switched to wearing electronically welded plastic shoes.

Discussion

Cr allergy is the third most common metal allergy, and affects 1–3% of the adult population (2). Leather as a source of Cr is well documented (3, 4). Total Cr contents in the ankle and dorsal foot area were measured in this case, but it should be noted that Cr^{3+} is added during the tanning process and is subsequently oxidized to Cr^{6+}, which is a more potent allergen than Cr^{3+}. A Cr allergy would explain the patient's reaction around his ankles. It would not, however, explain the lack of allergic contact dermatitis on the dorsa of the feet and soles.

Socks retain allergens from shoes (5), but this too cannot account for the regional difference in allergic reactions. Laboratory results showed similar levels of Cr at both the ankle and the foot, indicating that both areas

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were equally exposed to Cr contamination. A possible explanation for this difference is regional anatomical variation in the susceptibility of the skin to the development of allergic contact dermatitis.

Regional variation in allergic and irritant dermatitis was shown in 1965 by Hersle and Magnuson, who saw differences between the skin of the extremities and that of the back in patch testing (6). Similar findings have been made on the back and other parts of the body (7, 8). Regional variation of allergic contact dermatitis on the skin of our patient between his ankle and the rest of his foot could explain our findings.

Regional variation in percutaneous penetration exists. Feldmann and Maibach showed this phenomenon in multiple areas of the body, including the face, arm, ankle, and plantar aspect of the foot. When the forearm was used as reference, the plantar foot had 0.14-fold lower penetration, and the ankle had 0.42-fold lower penetration (9). The differences in percutaneous penetration between the ankle and plantar foot could possibly account for the differences in allergic contact dermatitis in our patient; skin penetration of Cr may not have been sufficient at the plantar foot to cause a reaction.

Regional variation has also been shown in cases of immunological and non-immunological contact urticaria (10, 11). Biophysical differences leading to regional variation in the skin of several dermatological entities led us to believe that it may also have a role in allergic contact dermatitis in anatomical sites in addition to that shown by Magnusson and Hersle. We also await information on the relationship between the tribology of the ankle and that of the foot (12). We do not wish to overinterpret these observations until more such examples become available.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the NIOSH.

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