

Allergic contact dermatitis in a wastewater treatment worker: The role of sodium hypochlorite

Lara Gruye, BA¹, Robert J. McCunney, MD, MPH, MS^{2,3}, Kathleen Buchheit, MD^{3,4}, Ari M. Goldminz, MD^{3,5}

¹Tufts University School of Medicine

²Brigham and Women's Hospital, Pulmonary Division, Occupational and Environmental Medicine

³Harvard Medical School

⁴Brigham and Women's Hospital, Division of Rheumatology, Allergy and Immunology

⁵Brigham and Women's Hospital, Department of Dermatology, Contact Dermatitis and Occupational Dermatology Program

Corresponding Author:

Ari M. Goldminz, M.D.

Brigham and Women's Hospital

850 Boylston Street, Suite 437

Chestnut Hill, MA 02467

Email Address: agoldminz@bwh.harvard.edu

Telephone Number: (617) 732-9090

Fax: (617) 232-1043

Financial Disclosures: A.M.G. is an investigator with research grants from Regeneron and The Human Skin Disease Research Center. A.M.G.'s wife owns stock in Johnson and Johnson.

Conflicts of Interest: None relevant.

Keywords: systemic allergic contact dermatitis, case report, hypochlorite, bleach, occupational

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/cod.13707

Case Report: A 52-year-old man presented with a three-year history of pruritic papules on the bilateral, lateral forehead (**Figure 1**). He experienced flares when at his workplace (wastewater cleaning facility) and improved when away from work. Occupational exposures included sodium hypochlorite, hydrogen peroxide, ferric chloride, and other chemicals. He did not handle chemicals directly or typically wear a mask or rubber gloves at work. He did not use hair dye or leave-in hair products, such as gel. Initial treatment with topical corticosteroids led to temporary improvement. A skin biopsy showed a superficial perivascular and perifollicular lymphocytic infiltrate with eosinophils consistent with a hypersensitivity reaction.

Patch testing was performed using our 80-allergen standard series as well as ferric chloride and hydrogen peroxide. At 72 hours, there was an extreme reaction (+++) to gold sodium thiosulfate, a strong (++) reaction to 1,3 diphenylguanidine, and weak reactions (+) to p-phenylenediamine, carba mix, potassium dichromate, fragrance mix I, ammonium persulfate, and propylene glycol. A semi-open test to sodium hypochlorite (0.025% aqueous) demonstrated no reaction at 48 hours, but a positive reaction at 96 hours that persisted through day 7 (**Figure 2**). After several weeks of strict, non-occupational allergen avoidance (e.g. products and ingested sources), there was no improvement in his dermatitis.

He fulfilled at least 5 of 7 criteria for occupational causation and aggravation.¹ Given the isolated forehead involvement, it was recommended he use petrolatum and textile barriers on the forehead to prevent direct skin exposure to hypochlorite. However, after one month there was no improvement. After 2-3 weeks away from work his dermatitis and symptoms resolved and remained clear for the following 11 weeks while off site. We therefore suspected a recall reaction on the forehead caused by inhaled hypochlorite. He returned to work at an alternative site, away from wastewater treatment chemicals, and developed mild forehead irritation suspected to be secondary to office cleaning materials in the setting of COVID-19.

Discussion: There are few reports of ACD due to hypochlorite. Most commonly, cases have occurred in the setting of accidental occupational or home exposures, intentional application for cutaneous infections, or use of chlorinated swimming pools.²⁻⁴ Most commonly delayed-type hypersensitivity (type IV) reactions have been described, but cases with immediate, urticarial reactions have also been reported.

Previous authors have reported positive reactions to diluted bleach at 0.1% and 0.05% hypochlorite concentrations, and a negative reaction at 0.01%.⁴ Irritant reactions were observed in 15/69 controls at a 2% aqueous solution of hypochlorite.

Systemic ACD can occur through varied routes of exposure, including inhaled. Activation of local skin memory likely through retained T cells at the affected site can manifest as generalized or localized dermatitis.⁵ In one study 21 patients with prior positive patch test reactions to isoeugenol or hydroxy-isohexyl-3-carboxaldehyde (lyral) were exposed to their allergenic fragrance through inhalation. Two patients experienced flares at sites of existing dermatitis and another developed pruritus after exposure.⁵

Work at wastewater treatment facilities has also been associated with gastrointestinal illnesses and a variety of nonspecific symptoms, ranging from fatigue to headaches, among others.⁶ The process of wastewater treatment includes a primary effort which removes various solid materials, including organic matter such as vegetation; a secondary effort which focuses on digestion of the human waste by bacteria; and a third step which involves chlorination of the water that can enable the water to be used as drinking water.

Our case illustrates the importance of considering both unusual contact allergens (hypochlorite) routes of exposure (inhaled), and the role of workplace exposures to elucidate an otherwise common clinical presentation.

References:

1. Toby Mathias CG. Contact dermatitis and workers' compensation: Criteria for establishing occupational causation and aggravation. *Journal of the American Academy of Dermatology*. 1989;20(5):842-848.
2. Hostynek JJ, Patrick E, Younger B, Maibach HI. Hypochlorite sensitivity in man. *Contact Dermatitis*. 1989;20(1):32-37.
3. Osmundsen PE. Contact dermatitis due to sodium hypochlorite. *Contact Dermatitis*. 1978;4(3):177-178.
4. Habets JM, Geursen-Reitsma AM, Stolz E, van Joost T. Sensitization to sodium hypochlorite causing hand dermatitis. *Contact Dermatitis*. 1986;15(3):140-142.
5. Schnuch A, Oppel E, Oppel T, et al. Experimental inhalation of fragrance allergens in predisposed subjects: effects on skin and airways. *Br J Dermatol*. 2010;162(3):598-606.
6. McCunney RJ. Health effects of work at waste water treatment plants: a review of the literature with guidelines for medical surveillance. *Am J Ind Med*. 1986;9(3):271-279.

Figure 1: Pruritic papules on the patient's lateral forehead.

Figure 2: Persistent reaction to semi-open test of sodium hypochlorite (0.025% aqueous) at day 7.



