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Allergic contact dermatitis caused by *N,N*-diethyl-*p*-phenylenediamine used in water quality analysis

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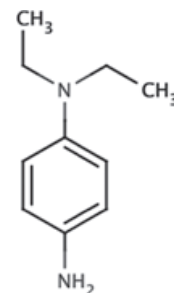
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N,N-Diethyl-*p*-phenylenediamine (DPD; Fig. 1) is a frequently used chemical for measuring free chlorine (Cl_2 , HOCl , ClO^-) and combined chlorine (NH_2Cl , NHCl_2) in drinking water. DPD can be used as an indicator for both acid–base and oxidation reactions (1). Herein, we report a case of allergic contact dermatitis caused by DPD used in water quality analysis.

Case Report

A 28-year-old woman with mild atopic dermatitis started work as an analyst of water quality 2 years previously, where she came into direct contact with chemicals, including DPD, without using gloves. Before starting this job, she had a 1-year history of hand dermatitis with erythema. After she started the new job, the hand dermatitis worsened; there was an itchy erythematous rash with small blisters, and erythema appeared on her arms, legs, and neck. She had never dyed her hair.

We performed patch testing with the Japanese baseline series and chemicals used at her workplace, using Finn Chambers® (SmartPractice, Phoenix, AZ, USA) mounted on Scanpor® tape (Norgesplaster AS, Vennesla, Norway). The tests were applied to the upper part of her back for 2 days, and read on D2, D3, and D7, according to International Contact Dermatitis Research Group criteria. The patient showed a positive reaction to DPD at the following concentrations: 1% aqua (D3, +; D7, +); 0.1%



CAS number: 93-05-0

Molecular formula: $\text{C}_{10}\text{H}_{16}\text{N}_2$

Molecular weight: 164.25

Fig. 1. Chemical structure of *N,N*-diethyl-*p*-phenylenediamine.

aqua (D3, +; D7, +); 0.01% aqua (D3, +; D7, +); and 0.001% aqua (D3, –; D7, +). She had no reactions to other ingredients and allergens, including *p*-phenylenediamine (PPD) and *p*-diethylaminobenzenediazonium (DDA). We also performed patch testing on 3 persons with DPD as normal controls, and they showed negative reactions. From these findings, the patient was diagnosed with allergic contact dermatitis caused by DPD.

Discussion

DPD is a para-amino compound that has benzene ring with amine and diethylamine in para-substitution, and it is soluble in water, but not volatile. DPD is used in the form of DPD sulfate for measuring free chlorine and combined chlorine in drinking water (1, 2). This method is used in many countries. In this case, the patient came into contact with chemicals, including DPD, without the use of gloves, resulting in allergic contact dermatitis on her

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hands caused by DPD. We also considered the cutaneous lesions other than her hand eczema to be autosensitization dermatitis. However, she came into contact with DPD as a powder, so there is a possibility of airborne contact dermatitis. Only 2 cases of allergic contact dermatitis caused by DPD have been reported. Kato et al. described a case of occupational allergic contact dermatitis caused by DPD in the Japanese literature in 1991 (3). The occupation of the patient in that case was water quality analyst, the same as in the present case. Their patient reacted positively to DPD and DDA. This reflects a cross-reaction

between DPD and DDA, as their chemical structures are similar. However, our patient did not react to DDA and PPD. DPD is also used in the development of photographs, and Aguirre et al. described a case of contact dermatitis caused by the colour developers CD1, CD2, CD3, CD4 and DPD in 1992 (4). In the aforementioned 2 cases, the positive patch test concentrations of DPD were 5% aqua (3). and 1% pet. (4), but, in our case, the patient reacted positively to 0.001% aqua. This suggests that DPD has the potential to cause allergic contact dermatitis even at very low concentrations.

References

- 1 Gordon G, Sweetin D L, Smith K, Pacey G E. Improvements in the *N,N*-diethyl-*p*-phenylenediamine method for the determination of free and combined residual chlorine through the use of FIA. *Talanta* 1991; **38**: 145–149.
- 2 Lima G F, Brondi A M, Paiva A L S F, Tarley C R T, de Oliveira A F, Wisniewski C, Luccas P O. Direct introduction of water sample in multisegmented flow-injection analysis for sulfide determination. *Anal Sci* 2011; **27**: 309–313.
- 3 Katoh J, Tanii T, Ishii M, Yoshioka K, Shindo K, Hamada T. A case of contact dermatitis caused by *N,N*-diethyl-*p*-phenylenediamine sulfate. *Skin Res* 1991; **33** (Suppl. 10): 83–87.
- 4 Aguirre A, Landa N, González M, Díaz-Pérez J L. Allergic contact dermatitis in a photographer. *Contact Dermatitis* 1992; **27**: 340–341.