

Severe occupational chromium allergy despite cement legislation

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Occupational skin disease related to or caused by contact with cement and wet concrete is well known, and has generally been associated with sensitization to hexavalent chromium, caustic burns, and irritant dermatitis (1, 2). A limitation of hexavalent chromium in cement to 2 ppm, by the addition of ferrous sulfate, was introduced in

Sweden, Denmark and Finland in the 1980s. The same limit value was introduced in the EU in 2005, and is now part of the European chemicals regulation REACH (3). Contact allergy to chromium has become less frequent in construction workers (3).

This case of rapidly developing chromium allergy resulting from work with concrete is reported as a reminder of the persistent occupational allergy risk.

Case Report and Chemical Analysis

A 24-year-old concrete worker was referred to our outpatient cutaneous allergy clinic. He had no history

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Fig. 1. (a) Manual work on a wet concrete element with grossly insufficient protection of the skin. (b) Hand eczema. (c) Foot eczema.

of skin disease before 2010, when he became employed at a concrete element factory with 100 employees and an occupational health service.

Within 22 months of work, he experienced episodes of acute burns on the hands, and then dermatitis on his hands, forearms, feet, legs, trunk, eyelids, and forehead. He used half-dipped textile gloves and shoes provided by the employer, and a short-sleeved shirt (Fig. 1). Some improvement was achieved by a change to rubber gloves, rubber boots, and a long-sleeved shirt. The dermatitis cleared after 4–6 weeks of vacation, sick leave for 4 months, and transfer to work without contact with concrete. The patient had a relapse after 1 day of cleaning up after excess concrete water flooding. Currently, he has no direct contact with concrete or cement, but still has mild eczema related to cement dust.

Contact allergy to chromium was diagnosed in 2012 by a general dermatologist. Topical corticosteroid treatment and peroral antibiotics gave temporary relief. Our team comprising an occupational dermatologist, a hygienist and a counsellor investigated the patient. He was patch tested with the Swedish baseline series, a rubber series, products from the workplace, and a serial dilution of potassium dichromate. He tested positive to potassium dichromate down to 0.015%. He had been in daily, massive contact with wet concrete (Fig. 1), cement powder, and excess water from the curing concrete on the elements and floor.

Samples of dry cement powder, wet concrete and excess water were taken from the work site for analysis. The pH of the excess water was 11.4. Approximately 1 g of the cement powder and 1 g of the concrete

samples were extracted in 50 ml of artificial sweat (1.0 g/l urea, 1.0 g/l lactic acid, 5.0 g/l NaCl, pH 6.5) and in ultrapure water (pH 5.95), respectively, at 30°C for 1 hr, and continuously gently shaken (25 cycles/min, 12°, bilinearly). The pH of the solutions increased from 6–6.5 to 10–12. Hexavalent chromium in the solutions was analysed with a photospectrometric method (4). The concentration of hexavalent chromium in the cement corresponded to 2.7 ppm (in dry weight) by extraction in artificial sweat, and 2.1 ppm by extraction in water; it was 0.083 ppm directly in the excess water. Total chromium was analysed with atomic absorption spectroscopy. As judged from these measurements, no significant amounts of trivalent chromium were present.

Discussion

Our young patient had, within < 2 years in a concrete factory, developed burns, contact dermatitis, contact allergy to chromium, and a reduced ability to work. The protective equipment provided was insufficient, and the company had failed in protecting its workers. We cannot tell whether, or by how much, the limit value of hexavalent water-soluble chromium in cement (2 ppm) (5) might have been exceeded during the employment. It should be considered that hexavalent chromium is deposited onto the skin, clothes, gloves, and shoes, and is accumulated by every single contact with concrete, cement, and contaminated excess water. This case illustrates that adequate protective equipment and careful occupational hygiene are crucial for prevention and work safety in concrete work.

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