44 Chromium

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Core Messages

- Hexavalent chromium (salt) is a form of chromium responsible for sensitization and contact dermatitis in chromate allergy.
- Exposure to chromium is often occupational and is commonly seen among building workers handling cement, leather workers, electroplaters, welders, and painters.
- Addition of ferrous sulfate has reduced the incidence of chromate allergy in the Scandinavian countries, since it decreases the concentration of hexavalent chromate in cement.
- Simple office-based tests are helpful in detecting chromium in objects.
- Patch testing with chromate (in chromium-sensitive subjects) to detect the minimum elicitation threshold (MET) is best done by using serial dilutions of Cr(III) and Cr(VI).
- Chromium can cause lipid peroxidation, nephrotoxicity and affect the immune system.
- Reduction or elimination of exposure is the best method of prevention of chromium-induced contact allergy.

1 Introduction

Chromium is a metallic element that is commonly found in the environment. Cement was one of the earliest agents incriminated in the causation of chromate dermatitis, with a high incidence among construction workers (handling wet cement). Exposure to chromium may be occupational or household with the skin and mucus membranes both being affected. The risk of exposure to chromium is high among other industries/professions such as leather tanning, chrome plating, welding, carpentry (handling of chromated metal products – screws and fittings), painting (also water coolants), and printing. In susceptible individuals, bleaches and detergents and stainless steel utensils containing chromium may also be potential causes of chromate sensitization.

Chromium is derived from the Greek word *chroma* meaning color due to the brightness of many of its salts. It can occur in every one of the oxidation states from −2 to +6, but the ground states 0, +2, +3, and +6 are common (Love 1983). The metal chromium in itself does not act as an allergen, but does so, in combination with a protein. Only the trivalent and hexavalent salts are able to act as haptens and form potentially antigenic bonds with proteins. It is highly resistant to corrosion in the atmosphere and many aqueous solutions, and is an unlikely cause of contact allergy.

2 Toxicity

While trivalent chromate is not considered toxic, hexavalent chromate has significant toxic effects. In sufficient concentrations it can cause respiratory symptoms such as bronchitis (Langard 1983) and asthma (Fernandez-Nieto et al. 2006), irritant dermatitis and chrome ulcers of the skin and mucous membranes, affect the immune system (Snyder et al. 1996) and also induce cancer, particularly of the lung (Bidstrup 1983).

Its effects on the immune system are demonstrated by the significantly lower levels of IL-6 in workers exposed to chromium, as compared to the normal population (Snyder et al. 1996). However, it was found that exposure to Cr(VI) in early stages can stimulate IL-6 and IL-8 and cause a fall in the percentage of B-cells (Kuo and Wu 2002).

2.1 Chrome Ulcers

The commonest symptoms associated with the irritant effect of chromates are chrome ulcers/holes occurring either on the skin (cement workers) or nasal septum (electroplaters and lithographers). The ulcers occur as 2–5 mm punched out lesions that heal with scarring, when the patient is removed from the source. Necrosis of cartilage (but not bone) can ensue but malignant change does not occur (Williams 1997).

T. Rustemeyer, P. Elsner, S.M. John & H.I. Maibach (eds.), *Kanerva's Occupational Dermatology*,
DOI 10.1007/978-3-642-02035-3_44,

In 1978, there were about 100 reported cases of chrome ulcers occurring in the UK (Burrows 1978).

The ulcer is formed due to the toxic necrotizing action of chromium on tissue. A recent report demonstrated that Cr(VI) causes mitochondrial-dependent apoptosis of the dermal fibroblasts by disrupting their actin cytoskeleton (Rudolf et al. 2005), contributing to the formation of an ulcer. In addition, workers prone to ulcer formation seem to have a lower incidence of allergic contact dermatitis (Walsh 1953). This is probably because the ulcer impairs the ability of the skin to mount an immune response.

An active program of reducing chromate contamination at workplaces can significantly reduce the incidence of chrome ulcers (Dornan 1981; Williams 1997).

3 Contact Dermatitis

3.1 Irritant Contact Dermatitis

Irritant dermatitis is seen particularly in workers exposed to chrome, where the exposure to chromium is high.

3.2 Allergic Contact Dermatitis

Dermatitis occurs more commonly with Cr(VI) than Cr(III) chromate. Cr(III) binds very readily to protein, and thus penetrates the skin poorly; little trivalent chromate gets past the stratum corneum. On the other hand, Cr(VI) penetrates easily and deeply into the dermis where it is transformed to Cr(III), which results in the formation of hapten-protein complex capable of being processed as an allergen. Guinea pig sensitization with Cr(III) is difficult; however, once sensitized, they react to patch testing in a similar fashion to those sensitized with Cr(VI) (Polak 1983).

3.3 Patch Testing

The standard test material is potassium dichromate in petrolatum (0.5%, Europe; 0.25%, USA). At these concentrations contact allergy can be elicited, besides being close to the concentration at which irritant reactions can occur (Burrows 1987). Patch testing with 0.5% and 0.375% potassium dichromate will produce a number of irritant reactions, whereas patch testing with lower percentages, while producing fewer irritant reactions, will miss some allergic reactions (Burrows et al. 1989). Consequently, 0.25% is probably a safer percentage in the hands of those lacking experience in patch testing.

A population-based, serial dilutions patch testing method (➲ *Fig. 44.1*), demonstrating the wide range in patient/worker sensitivity has been published (Nethercott et al. 1994). This method implements the delivery of a controlled amount of *allergen per surface area* of skin, for determination of the *minimum elicitation threshold* (MET). The high water solubility of compounds $K_2Cr_2O_7$ [Cr(VI)] and $CrCl_3$ [Cr(III)] is exploited for their application as T.R.U.E. test patches. The serial dilutions of Cr(III) and Cr(VI) used are given in ➲ *Table 44.1*.

4 Incidence of Chromate Allergy

The incidence of positive patch tests to chromate depends on the subset of workers being studied and illustrates the risk of getting sensitized. In a study of healthy volunteers, the patch test positivity to chromium was 0.5% in those without apparent contact with chromate, as compared to 1.8% in those who had contacted chromate (Peltonen and Fraki 1983). A similar incidence of 1.7% in chromate-pigment workers (Decaestecker et al. 1990), and 2.9% in prefabrication-construction factory workers (Goh et al. 1986b) with normal skin, has been noted. In a review of world literature, the incidence of chromate sensitivity in a routine patch testing clinic was found to be 7.9% (Nethercott 1982). Patch test positivity to dichromate was noted in 6.8% of 1,159 men and 2.8% of 1,823 women, elsewhere (Peltonen and Fraki 1983). Of these, 16.1% of the men and 18.1% of the women had a present or past history of atopic dermatitis; however of the 390 patients with atopic dermatitis as a primary diagnosis, only 1.3% showed a positive reaction to dichromate. These high figures of apparent allergy to dichromate must be accepted with a certain amount of reserve, bearing in mind the potentially irritant nature of 0.5% potassium dichromate, which could give irritant reactions in those with active skin disease. Indeed, Fischer and Rystedt (1985) found that only 40% of their positive chromium patch tests were relevant.

In a skin clinic, the incidence of chromate sensitivity is close to 1–2% and, if the figures are higher, then some special reason should be sought. The data from two British occupational surveillance schemes found 22,184 cases of occupational contact dermatitis over a period of 11 years (1993–2004), of which chromium accounted for 6% of the cases with a male:female ratio of 5:1(Athavale et al. 2007). The Finnish register of occupational diseases observed a 5.6% incidence of ACD due to chromium over a 7 year period (1991–1997). The incidence of chromium allergy per 10,000 working years in different occupations has also been elaborated in ➲ *Table 44.2* (Kanerva et al. 2000).

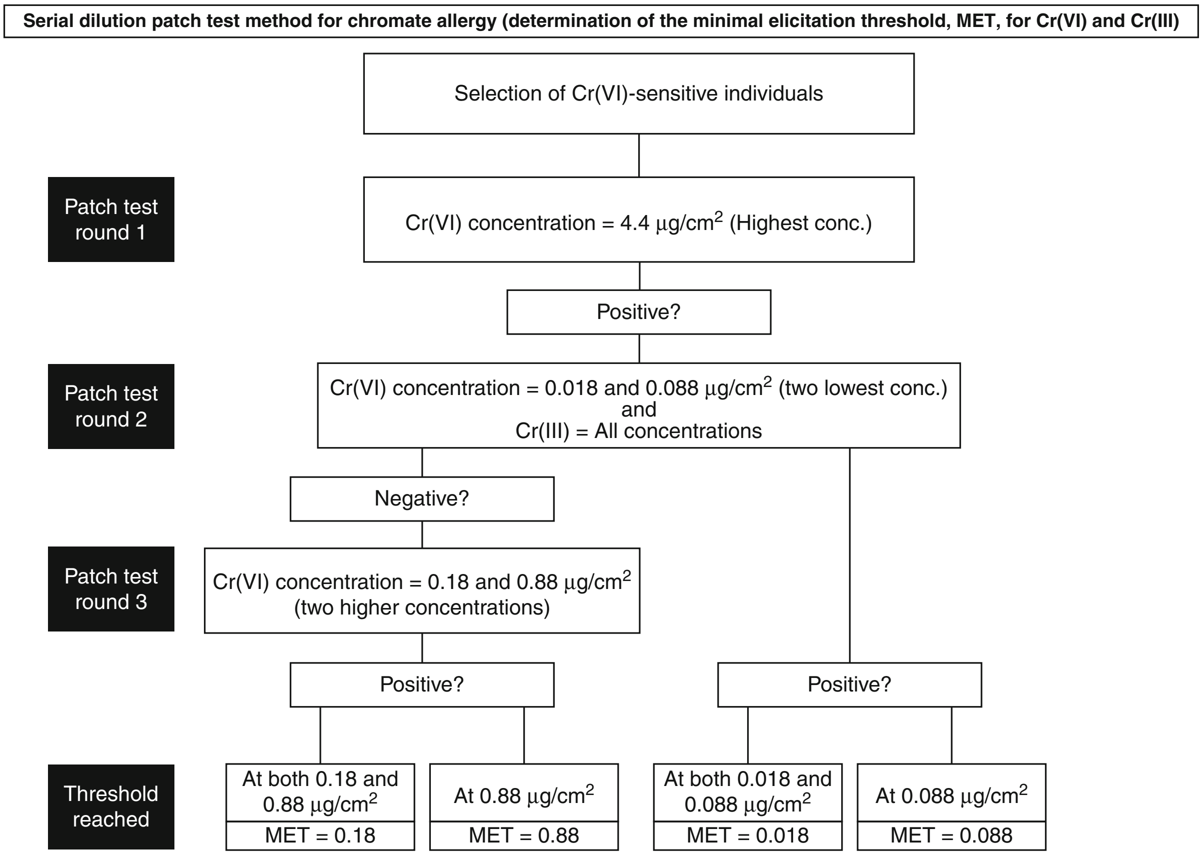

Fig. 44.1
Serial dilution patch test method for determination of minimum elicitation threshold in chromate allergic individuals (Nethercott et al.)

Table 44.1
Serial concentrations (µg/cm²) of Cr(III) and Cr(VI) used

Cr(III)	0.66	3.3	6.6	33	–
Cr(VI)	0.018	0.088	0.18	0.88	4.4

The prevalence of chromate allergy in Denmark decreased significantly from 3.6% (in 1985) to 1% (in 1995), and then increased again to 3.3% in 2007 (Thyssen et al. 2009).

5 Exposure to Chromium

Contact exposure is possible with the following compounds (Burrows and Adams 1990):

- Metals
- Analytic standards/reagents
- Anticorrosion agents
- Batteries
- Catalysts (for hydrogenation, oxidation, polymerization)
- Ceramics
- Cement
- Drilling muds
- Chromium lignosulfonates (from sodium dichromate using lignosulfate waste)
- Electroplating, anodizing agents
- Engraving
- Explosives
- Fire retardant
- Galvanized sheeting
- Hardeners, resins (aircraft industry)
- Leather
- Magnetic tapes
- Metallic chromium
- Milk preservatives
- Paints and varnishes

Table 44.2
Occupational exposure to chromate per 10,000 working years

Occupations	Incidence
Tanners, fellmongers, pelt dressers	12.20
Cast concrete product workers	6.94
Leather goods workers	4.71
Metal plating and coating workers	3.66
Bricklayers	3.44
Reinforcement concreters	2.79
Building workers	1.32

- Paper
- *Chrome cake* (sodium sulfate/dichromate)
- Photography
- Roofing
- Stainless steel
- Sutures
- Tanning leather
- Textile mordants and dyes
- Television screens
- Welding
- Wood preservatives

Chromium is used in the industry as follows:

1. *Metallurgical industries* (85%): primarily stainless steel. It is added to harden the metal and provide high-temperature strength and corrosion resistance. It is also used in combination with aluminum, zirconium, and zinc alloys.
2. *Chemical applications* (8%): predominantly used in leather tanning followed by timber preservation and in paints, inks, textiles, and as pigments in plastics. Zinc and strontium chromates are used as corrosion inhibitors in priming paints. Chromium is used as a catalyst in drilling muds, water treatment, electroplating, passivation treatments of metal, and as a preservative in milk testing.
3. *Refractory bricks* (7%): useful in refractory linings for furnaces and the kilns of the cement industry, and in molding sands in foundries because of its high melting point and relatively low cost.

5.1 Cement

Cement, of course, is by far the most common and best-recognized cause of chromate allergy. Cement contains varying amounts of chromate; for instance, it was found that the chromate content of water-soluble cement in Australia varied from less than 1 ppm to 124 ppm, with the majority tested showing less than 10 ppm (Ellis and Freeman 1986). Cement, upon addition of water, becomes alkaline (pH,12) and is probably a factor in facilitating sensitization to the chromate in cement. This probably explains the rarity of allergic contact dermatitis to chromate in cement-manufacturing workers or in those handling dry, powdered cement. The percentage of patients with cement dermatitis who have positive patch tests to chromate is probably 80–85%, but some (Conde-Salazar et al. 1995) have found lower levels (42%; 20% had positive patch tests to cobalt). Chromate in cement derives from the ingredients (clinker), the machinery used in processing (grinders, etc.), and from refractory bricks. Most of the chromate that goes into the cement is trivalent, but a varying proportion of this is changed to hexavalent chromate during manufacture.

This is important, because in future it is likely that the amount of chromate in cement will decrease due to the following factors: (1) a number of magnesium chrome refractories are currently beginning to use magnesium aluminate (spinal refractories) (Tandon and Aarts 1993); (2) slag from iron blast furnaces, which contains little or no chromate (Goh and Gan 1996), is likely to be increasingly used as a clinker substance; (3) with increased mechanization, cement is being decreasingly handled, leading to a reduction in cement dermatitis (see Chap. 48, “Cement”); and (4) addition of ferrous sulfate to cement (originally reported by Fregert et al.) decreases the concentration of hexavalent chromate in cement (Fregert et al. 1979). This has been substantiated by the findings of significant decreases in the urinary chromium of workers with hand dermatitis after the addition of ferrous sulfate in cement (Chou et al. 2008), and chromium allergy due to cement from 12.7% in 1989–1994 to 3% in 1995–2007 (Thyssen et al. 2009).

5.2 Anticorrosion Agents

Chromates are still being exploited as anticorrosion agents in water-cooling systems and paints. Their use persists despite their toxicity, as they are very effective, persistent, relatively inexpensive agents, and moreover, they do not form insoluble complexes as some other anticorrosion agents do.

5.3 Welding

Chromium may be present in electrorods used in electric arc welding, together with the metals which are being welded. During welding, chromium is oxidized to hexavalent chrome (present in fumes), which causes dermatitis (Fregert and Ovrum 1963; Shelley 1964).

5.4 Leather

The incidence of chromate allergy in footwear dermatitis varies in different studies. Trivalent chromate is used; hence, the sensitization potential is low. Nevertheless, chromate allergy should always be considered in shoe dermatitis, and possibly even as a factor in hand dermatitis due to wearing of leather gloves. Chromate is used in leather tanning, as a water-repellent [Cr(III) stearate chloride], stain-repellent [Cr(III) and fluorinated carboxylic acids], and as a dye. In those carrying out tanning, the sensitization risk is increased because of contact with other irritants, oxidation of small amounts of Cr(III) to Cr(VI) (Hansen et al. 2002) and wetness in the process of tanning. In Denmark, 35% of leather products had Cr(VI) content exceeding the detection limits of 3 ppm (Hansen et al. 2002), and an increase in the prevalence of chromate allergy due to leather exposure from 24.1% during 1989–1994 to 45% during 1995–2007, ($p < 0.02$) has been noted (Thyssen et al. 2009), further proving the role of chromate in leather allergy. The histocompatibility antigens (HLA-B8 and DR-3 alleles) have been incriminated in the susceptibility of patients to immunotoxicity with Cr(VI) (Mignini et al. 2004).

5.5 Chrome Plating

Chrome plating, in which chromic acid and sulfuric acid are used, provides a significant risk for exposure to chromate (Lee and Goh 1988).

5.6 Galvanizing

Galvanizing iron with zinc, either by electroplating or dipping in molten zinc, protects it from rusting. Coating with chromate enhances the protective effect. However, this has led to its recognition as a cause of dermatitis to chromate (Rycroft and Calnan 1977).

5.7 Pigments

Chromates are used as:

1. Dye substances (e.g., lead chromate): They are used in an insoluble hexavalent form and, thus, not relevant as a skin hazard. Chromium oxide, a trivalent form, is used in artists' paints and ceramics.
2. Soluble sodium dichromate: Used as a chelating agent in the presence of acid to yield an insoluble dyestuff. This is particularly used in wool processing.
3. Dyestuffs: This occasional addition prevents wool from reducing the dye.

5.8 Printing

Printing was a relatively common source of allergy to chromate (Burrows 1983); however, with the use of acrylates, this has become infrequent.

5.9 Stainless Steel

Most stainless steel contains about 18% chromate, but this can be as high as 30%. A thin layer of chromium oxide is formed under conditions of acidity and high chloride content. The oxide film may break down and permit corrosion to occur. Corrosion products are trivalent, but with an oxidizing agent present, hexavalent chromium could be produced. The literature on leaching of chromium from various cooking utensils has been reviewed (Kanerva 1997). It has been concluded that chromium is leached only in small amounts, from stainless steel in contact with marked acidity and high temperature. It is unlikely, that the amount leached from stainless steel utensils – even with acidic food – would exceed 50 µg/day, the amount considered to be beneficial to health. A similar observation was made when the difference in nickel and chromium content was studied in 11 habitual menus cooked in different grades of stainless steel utensils (Accominotti et al. 1998).

5.10 Bleaches and Detergents

A large percentage of female patients tested positive to chromate on routine patch testing, without any obvious cause. A case of a person previously sensitized to dichromate, developing inflammation of the sweat ducts by dipping the forearm in a solution containing 25 µg/mL of chromate for 30 min, has been reported (Nethercott et al. 1996). Allenby and Goodwin (1983) found one patient who reacted to as little as 1 ppm and could not rule out detergents as a factor in chromate dermatitis. A study done on various commonly used detergents in India showed chromate levels (by diphenyl carbazide spot test) to be less than 10 ppm, indicating that chromium may not be an important cause of dermatitis (Krupashankar et al. 2009). Note that the spot test may, because of its detection limits, have missed small amounts of chromate. In Israel, it was found that

90% of detergents and bleaches contained chromium levels higher than 1 ppm, thus resulting in a high incidence of chromium allergy (Ingber et al. 1998). Therefore, to prevent the development of chromium allergy and to decrease the incidence of chromium dermatitis in already sensitized individuals, it is now recommended that the chromium content of household products should not normally exceed 1 ppm (Basketter et al. 2003).

It has been suggested that contact with ashes in cigarette trays could be an explanation of some cases of chromate allergy in females (Clemmensen et al. 1981). The ashes contain a relatively high amount of chromate, and the cloth used to wipe these (by cleaners) would contain increasing concentrations of chromate as the day went on.

5.11 Other Sources of Contact Dermatitis

- Magnetic tapes (Krook et al. 1977)
- Paper pulp manufacture (Pirila and Kilpi 1954; Conner 1972; Fregert et al. 1972)
- Cutting fluids (Calnan 1978a)
- Tire fitters (Burrows 1981)
- Milk testers (Huriez et al. 1975; Rogers and Burrows 1975)
- Food laboratories (Pedersen 1977)
- Machine oils (Oleffe et al. 1971; Einarsson et al. 1975; Calnan 1978b)
- Pigment in soap (Mathias 1982)
- Resin hardeners containing high amounts of chromate (this is especially seen in aircraft workers) (Handley and Burrows 1994)
- Antifreeze (Freeman 1995)

6 Detection of Chromate

Chromate is often a hidden allergen, and in any situation where a patient has a positive patch test to chromate and has contact dermatitis, one should always suspect the possibility of contact with chromate; spot testing for chromate can be helpful.

6.1 Spot Test for Detection of Hexavalent Chromium (Chromate)

Reagents:

(a) Reagent I: 1,5–diphenylcarbazide (1% wt./vol. in ethanol)
(b) Concentrated sulfuric acid

Investigative procedures:

- *Chromate on the surface of a solid object*: A few drops of each reagent are applied on a cotton swab. The cotton swab is thereafter rubbed against the surface of the object for 1 min. If chromate is present, a red-violet color appears.
- *Chromate in solutions*: To a sample of approximately 10 mL a few drops of each reagent is added. If chromate is present, a red-violet color appears.
- *Chromate in powders insoluble in water (cement)*: Cement is mixed with 10 mL water for some minutes. The mixture is then filtered and the filtrate is handled in the same way as described for chromate in solutions.

Reagent I must be prepared immediately before the investigation. Spot testing is not so accurate or easily carried out as the dimethylglyoxime test for nickel.

6.2 Acid Wipe Sampling

This technique detects the presence/amount of nickel, chromium, and cobalt in the skin of workers at their workplace. It is performed by an inductively coupled plasma mass spectrometer and has a high sampling efficiency (Liden et al. 2008).

7 Photosensitivity and Chrome Allergy

Photosensitivity has been suggested as a factor in chrome allergy, since many patients develop dermatitis on the exposed areas. This might be expected in a substance that is a potential airborne allergen (El Sayed and Bazex 1994). However, negligible amounts of chromate were found, in the atmosphere of a Singapore cement construction factory and a busy city center (Goh et al. 1986a). Patients have developed a more intense reaction when sites were irradiated with short-wavelength ultraviolet light (Wahlberg and Wennersten 1977), and recently, both immediate and delayed reactions on patch testing were noted, when subsequently irradiated with ultraviolet light (Manciet et al. 1995). However, White and Rycroft (personal communication) were unable to find an increased incidence of chromate sensitivity in patients with photosensitivity. Even though one can find a certain element of photosensitivity, this is unusual and rare.

8 Effect of Systemic Chromium

Chromium is an essential element, especially in glucose metabolism; and the daily addition of 200 mcg chromium to diet improved the metabolism of glucose in diabetics. It was found that 63% of patients with type 2 diabetes mellitus responded to treatment with chromium as compared to 30% with placebo (Wang et al. 2007). This was substantiated by Ghosh et al. who stipulated that the effect of chromium may be due to an increase in insulin action, rather than stimulation of insulin secretion (Ghosh et al. 2002).

However, a randomized double-blind placebo-controlled study in Netherlands did not find any relation between chromium administration and glycemic control (Kleefstra et al. 2007).

There have been several open studies on the systemic effects of chromate in patients with chromate dermatitis (Schleiff 1968) suggesting an association. Joensen et al. (1979) found that 11 out of 31 patients experienced a flare with 2.5 mg potassium dichromate. Veien et al. (1994), in a placebo-controlled oral challenge of 2.5 mg, found a significant number of flares. McMillen (1990), however, found no connection.

Chromium has been found to induce lipid peroxidation in humans, the precise mechanism of which is not known (Bagchi et al. 1995; Kasprzak 1995). Increased concentrations of chromium and malondialdehyde (product of lipid peroxidation) have been observed, in chromium-exposed workers. Therefore, malondialdehyde may be used as a biomarker for occupational chromium exposure (Huang et al. 1999).

Excessive chromium intake or contact has also been associated with nephrotoxicity (Zhang and Jin 2006).

The daily human chromium intake varies in different geographical areas, and is usually between 20 µg and 85 µg per day, although values up to "130 µg" per day have been reported (Kanerva 1997). In other studies from the USA, the daily dietary intake of chromium was estimated to be 5 µg and 100 µg per day (Kumpulainen et al. 1979; Anderson and Kozlovsky 1985). The doses used in these trials of oral aggravation of chromate dermatitis, therefore, bear no resemblance to anything one might meet in everyday life (even in exceptional circumstances), and do not offer any evidence that chromate dermatitis is aggravated by oral intake. While it is well recognized that nickel and cobalt implants can aggravate dermatitis, particularly in the vicinity of the implant, this does not appear to be a problem with chromium.

9 Prognosis

It is well documented that the prognosis in chromium dermatitis is probably worse than in any other form of dermatitis. A very small percentage was found to be clear after 10–15 years (Burrows 1972). This was later confirmed (Halbert et al. 1992), and a review of the prognosis of occupational hand dermatitis further highlighted the finding (Hogan et al. 1990). Outcome studies were performed before current understanding of exposure, protection, and therapeutics. In the authors' experience, at least in San Francisco, many workers have a good outcome.

10 Change of Occupation

Data pertaining to the benefits of a change in occupation are unclear, but common wisdom and clinical experience suggest that it would be beneficial. In a review of chromate allergy in 122 patients, followed up for 6–9 years, it was found that 62 (52%) continued in the same occupation and, of these, 55 (89%) had ongoing dermatitis and 7 (11%) had completely cleared despite continuing chromate exposure. The remaining 58 (48%) had completely changed their type of work since initial presentation and, despite this change dermatitis persisted in 40 (69%) workers. The period an individual continued in employment (with dermatitis) prior to change of occupation appeared to be a significant factor in improvement (Halbert et al. 1992).

11 Management

11.1 Prevention

Reduction of exposure is clearly the best method of prevention. Mechanization in the construction industry and allergen replacement, for instance, change to trivalent chromate for plating results in significant improvement (Burrows and Cooke 1980). A survey of the chrome industry reflected the need and scope for further considerable improvement, and efforts to improve hygiene have been worthwhile (Dornan 1981). In a study conducted at an electroplating facility, significant neglect of preventive measures was noted; workers wore internally contaminated gloves, de-gloved themselves in a manner which led to contamination of skin, did not wear personal protective equipment, and displayed unsafe habits (nose-picking) (Cohen et al. 1974).

Hence, employee education regarding high standards of personal hygiene accompanied by the presence of a "responsible person" trained in identifying and reporting any abnormal signs and symptoms among workers are important steps in preventing morbidity (Williams 1998). In addition, proper environmental control of chromic acid mists also needs to be taken into consideration.

Replacing Cr(III) with Cr(VI) in cement is underway in four countries (Norway, Sweden, Finland, and Denmark), which has led to a significant reduction in chromate dermatitis in the cement industry (Bock et al. 2003).

The universal adoption of this practice is hindered by:

1. The decreasing incidence of chromate allergy in the cement industry worldwide (irrespective of the addition of ferrous sulfate).
2. The cost of this preventative measures, which may be considered prohibitive by some. The cost of ferrous sulfate is £150/t/works for bag material; taking into account transport costs and possible price reduction for bulk orders, one could assume a delivered price of £150. The maximum effective level is likely to be 0.5% and, in some circumstances, would need to be 1%. For an annual cement production of 14 million tons in Britain, the additional cost would thus be between £10.5 million and £21 million. There would also be a capital cost of approximately £150,000 for each works. In the UK, there are 19 works, with a capital cost of three million pounds.
3. The change in refractory materials (Tandon and Aarts 1993) and raw materials (Goh and Gan 1996) used, which will anyway lead to a decrease in the amount of chromate in cement. Cement dermatitis is also reviewed elsewhere.
4. The use of dedicated rotary machinery for large-scale mixing, in many countries, thus decreasing skin exposure.

11.2 Barrier Creams and Protective Gloves

It is doubtful that ordinary barrier creams will provide any protective effect. Specific barrier creams that change hexavalent chrome into trivalent chrome have been suggested, including ascorbic acid (Valsecchi and Cainelia 1984), ascorbic acid with ethylenediamine tetra-acetic acid (Romaguera et al. 1985), dithionate (Wall 1982), tartaric acid plus glycine (Romaguera et al. 1985), and sodium metabisulfite (Burrows and Calnan 1965). Romaguera has also found a preparation containing silicone, glyceryl lactate, glycine, and tartaric acid to be effective in a clinical trial. A polymer resin with a chelating agent was found effective in suppressing nickel patch tests positivity (Niklasson et al. 1996). This is also effective in chelating chromate (Niklasson, personal communication). The utility of good protective gloves (Boman 2004) made of proper rubber must not be underestimated.

11.3 Treatment

One of the most important steps in improving prognosis is to isolate the patient from the source as soon as possible (Halbert et al. 1992). A discussion must take place with the patient, because improvement of their dermatitis cannot be guaranteed, and many patients will continue to experience discomfort even though they have no obvious further contact with chromate. Although a satisfactory explanation does not exist, the prolonged persistence in skin or the requirement of only minute quantities of chromate (as found in soil, paper, etc.) might account for the continuing dermatitis. Nevertheless, it is ideal, that the patient be relocated to another area of the company, where there is no exposure to chromate-containing compounds. Otherwise, treatment options remain the same, as for any other eczematous condition; emollients and use of topical steroids, when necessary.

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