Chromium or Chromate Dermatitis

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Last year some doubt arose about the real significance of the positive patch test for bichromate solutions, as positive patch tests and intra-cutaneous reactions for trivalent chromium compounds have been reported (Fregert et al.) and because trivalent chromium compounds, next to bichromate have often been found in the environment of patients.

The dispute centres around two different problems:

Are trivalent Cr compounds of importance in the sensitization process ?

Do they have a practical significance in the pathogenesis of the chromium dermatitis ?

Ad (1):

In our opinion, sensitization is not caused by bichromate but by a reduced, presumably trivalent compound originating in the dermis. Arguments in favour of this hypothesis may be found in the fact that bichromate salts are rather easily reduced by substances in epidermis and dermis. Moreover, Van Neer succeeded in sensitizing guinea-pigs to bichromate by injecting trivalent Cr compounds. In addition, in some guinea-pigs heavily sensitized by sensitization with Hunziker, s method (bichromate + Freund adjuvans), circulating antibodies against trivalent Cr were demonstrated.

The most important argument for the specific role of trivalent compounds are the positive reactions on intracutaneously injected trivalent Cr. The intensity of these reactions, however, remains much smaller than that on intracutaneously injected bichromate, if one uses the same concentration.

It is possible that the different reactions are determined by the difference in chemical and physical properties between tri- and hexa-
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valent Cr compounds. The permeability of whole skin in vivo and in vitro of chromium sulfate and chromium chloride is for instance $10,000 \times$ smaller than for bichromate (Spruit). The affinity of the trivalent Cr compounds to the skin proteins is much larger than that of the hexavalent (Mali, van Kooten, van Neer). Spruit however demonstrated that the very small concentrations of bichromate, which are encountered in the environment of the patient in real-life conditions are for the larger part detained in the dermal tissue by absorption.

By this mechanism a minimum concentration, necessary for the initiation of sensitivity, may be built up in the dermis.

Van Neer's recent experiments on pigs demonstrate the difficulty of using animal experiments in order to explain the mechanism of sensitization. Pigs are much more easily sensitized than guinea-pigs, the sensitization of man being somewhere in between. It may however be possible

that further research on the different mechanism of penetration and permeation of the various chromium compounds will yield a solution for the differences in behaviour between man, pig and guinea-pig.

Ad (2):

The actual role of tri- or hexavalent chromium compounds in cases of sensitization has to be investigated for each group of cases separately.

The first steps in the contact between the chemical and the dermal skin, i.e. the penetration into the skin and the permeation through the dermal skin are likely to be crucial.

They are determined by the pH concentration, reducing substances on the skin surface and the condition of the barrier between living and dead epidermis.

In cement dermatitis the high pH of the cement and the low concentration is unfavourable for the reduction of hexavalent chromium. The small concentrations also favour the retention of the chromium in the dermis. In contrast, the concentration of trivalent chromium seems not to be high enough to ensure a sufficient concentration in the dermis to initiate the process of sensitization.