

A study of chromium induced allergic contact dermatitis with 54 volunteers: implications for environmental risk assessment

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Abstract

Over the past 60 years, dose-response patch test studies by various methods have been conducted in an attempt to identify the minimum elicitation threshold (MET) concentration of hexavalent chromium (Cr(VI)) that produces an allergic response in Cr(VI) sensitive subjects. These data are not adequate, however, to provide an accurate estimate of the MET because of the variability in the patch testing techniques and the variability in diagnostic criteria used. Furthermore, the data were not reported in terms of mass of allergen per surface area of skin ($\text{mg Cr/cm}^2\text{-skin}$), which is necessary for conducting occupational or environmental health risk assessments. Thus the purpose of this study was to determine the MET (mg allergen/cm^2) for Cr(VI) and trivalent chromium (Cr(III)) by patch testing techniques. A patch test method that delivers a controlled amount of allergen per surface area of skin was used. A group of 54 Cr(VI) sensitised volunteers were patch tested with serial dilutions of Cr(VI) and Cr(III) to determine the cumulative response rate at several concentrations. The results indicate that the 10% MET for Cr(VI) based on the cumulative response was $0.089 \mu\text{g Cr(VI)/cm}^2\text{-skin}$. Only one of the 54 volunteers may have responded to $33 \mu\text{g Cr(III)/cm}^2\text{-skin}$, otherwise Cr(III) was unable to produce allergic contact dermatitis in these highly sensitive volunteers. Two supplemental studies were also conducted to assess whether the surface area of the patch and the concentration of Cr(VI) in the patch (related to patch thickness) were likely to influence the results. The data from these studies were used to assess the risk of developing allergic contact dermatitis due to contact with Cr(VI) and Cr(III) in soil. The findings indicated that soil concentrations at least as high as 450 ppm Cr(VI) and 165 000 ppm Cr(III) should not pose an allergic contact dermatitis hazard for at least 99.99% of the people in the community who might be exposed.