

Severe chronic inflammation of the mucous membranes in the eyes and upper respiratory tract due to work-related exposure to hexavalent chromium

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Abstract

Chronic inflammation of the skin and mucous membranes following prolonged exposure to high doses of toxic hexavalent chromium is well known in the occupational medical literature. Perforation of the nasal septum is a cardinal clinical feature. Late development of cancer in the respiratory system is established. A recently diagnosed case with an unusually severe affect on the eyes is described. The industrial usage of chromium and its toxicological profile is reviewed.

Key words: Chromium; Inflammation, chronic; Mucous membrane; Nasal septum, perforation; Respiratory tract neoplasms

Introduction

The toxic effect on skin and mucous membranes from prolonged exposure to hexavalent chromium in dust and vapour is well known in occupational medical literature (Bidstrup and Wagg, 1983; Lee and Goh, 1988). The cardinal clinical feature is inflammation of the nasal mucous membrane with perforation of the nasal septum.

In addition to its inflammatory effect on skin and mucous membranes hexavalent chromium is classified as a carcinogen. Mutagenicity has been demonstrated in *in vitro* tests and an excess mortality from pulmonary cancer and cancer of the nasal

cavity has been observed in exposed individuals (Machle and Gregorious, 1948; Hayes, 1988). As early as 1890 Newman described an adenocarcinoma of the lateral wall of the nose coexistent with a nasal perforation in a worker with a prolonged exposure to chromium (Newman, 1890).

Kidney damage has been reported, while damage to the liver has only been observed in accidental administration of large amounts of chromium compounds (Langard and Hensten-Petersen, 1981). A possible harmful effect of chromium on reproduction has not yet been clarified.

The exposure of workers to chromium in plants is still excessive in Eastern Europe and in Asian countries. The working

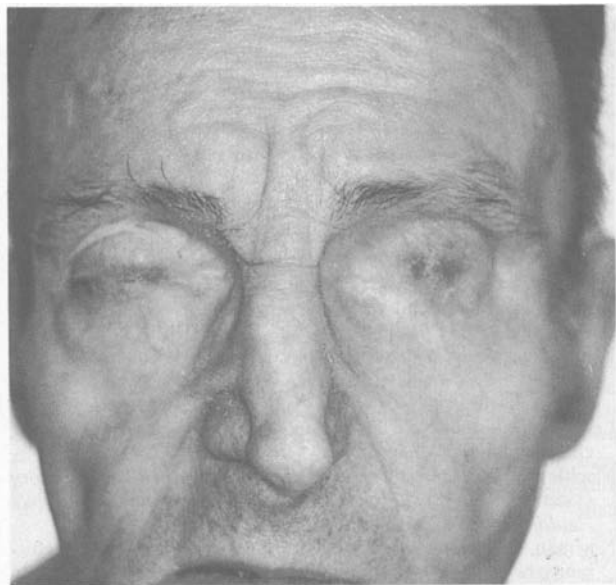


FIG. 1

Chronic kerato-conjunctivitis with cicatricial adhesion between the conjunctiva of the eyelid and the eyeball caused by prolonged exposure to chromium vapour.

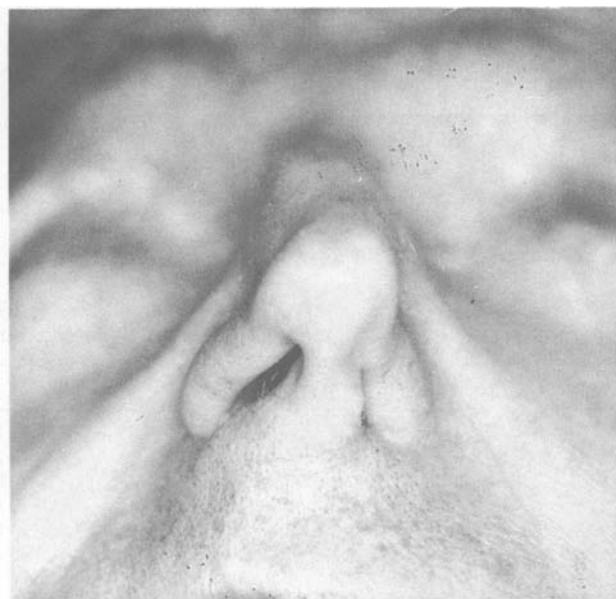


FIG. 2

The alae nasi characterized by severe cicatricial changes.

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environment has been improved in the Western World, but due to a latency period of several years between prolonged exposure and malignancy development claims for compensation are still occurring in this part of the world.

In this paper we describe an example of the typical harmful effects of chromium on the mucous membranes. In addition it is an extraordinary case because of the unusually severe affect on the eyes.

Case report

Between 1934 and 1982 a 70-year-old man daily chromium plated iron in vessels containing 2000–3000 l of 40°C chromium solution. The work, which was carried out in a small and narrow room, demanded continuous supervision. Thus the patient kept his face over the vessel most of the time and was severely exposed to chromium vapour. In spite of frequent whitewashing the walls and ceiling quickly became yellow-brown by chromium discolouration indicating insufficient ventilation.

The patient stopped working in 1982 due to complications from an operation for atherosclerosis in the femoral artery. Prior to this he had through many years suffered from severe nasal incrustation and daily epistaxis. In 1987 an otolaryngologist demonstrated a large defect in the nasal septum.

In 1991 the patient was admitted to our ENT department for assessment of the nasal cavity and the stomatitis. He was almost blind due to chronic kerato-conjunctivitis with cicatricial adhesion between the tarsal conjunctiva and the bulbar conjunctiva caused by exposure to the chromium vapour (Figure 1). Clinical examination demonstrated a large perforation of the nasal septum and stenosis of both nostrils by incrustation. Anosmia was demonstrated. Due to prolonged purulent nasal secretion both alae nasi were deformed by scar-tissue (Figure 2). The oral cavity and especially the hard palate was covered with painful granulations and fibrous ulcerations making it impossible for him to wear his dentures (Figure 3). The patient had suffered an unintentional weight loss of at least 15 kg over approximately four years.

Biopsies and immunofluorescent test from the oral ulcerations demonstrated microscopically chronic fibrous inflammation without evidence of malignancy or autoimmune disease especially not pemphigoid. Alternative possible causes of the clinical features such as syphilis, cocaine abuse or post-traumatic sequelae could be excluded. The patient was treated regularly with

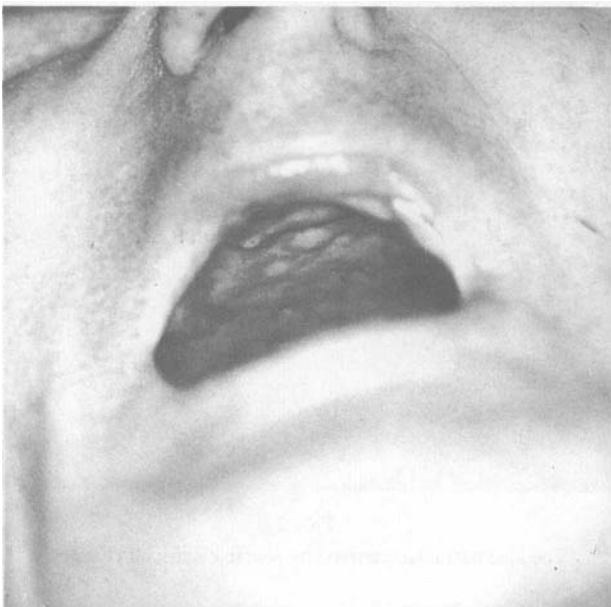


FIG. 3
Granulating ulcerations in the oral cavity.

nasal inhalations of saline solutions. Each month the nasal crusts were removed by an otolaryngologist, and the painful oral ulcerations were treated with lidocaine gel before meals.

The patient has received medico-legal compensation and because of the risk of developing malignancy he is being regularly examined.

Discussion

Chromium is a fragile, steel grey metal which is extracted from the widespread ferruginous chromite (FeOCr_2O_3) (Bidstrup and Wagg, 1983). The hardness and anticorrosive properties of chromium are used in various alloys (i.e. stainless steel and heat-resistant steel) and for chromium-plated metals and plastics. Various chromium compounds are used as dyes in car paint, textiles, plastics, glass and pottery. Chromium is widely used in leather tanning and along with arsenic and copper compounds in impregnation of wood. As an impurity chromium is found in coal, oil, feeding stuffs, fertilizers, chalk and clay, which is used, among other things, in cement manufacture.

Chromium combines in several oxidation phases: divalent (+2), trivalent (+3) and hexavalent (+6). Due to its acidic and oxidizing properties hexavalent chromium is very important in industry but it is also the most toxic (Bidstrup and Wagg, 1983). The patient described in the present case was exposed to hexavalent chromium in the compound chromium trioxide (CrO_3), which is a very strong oxidizing agent.

The case described here is unique because of the severe inflammation of the mucous membranes in the eyes. This has only sporadically been described in the medical literature. In spite of the mucous membrane changes which progressed after discontinuance of chromium exposure we could find no alternative explanation for the condition particularly as no evidence of pemphigoid or other autoimmune diseases was found.

Chronic inflammation of the mucous membranes due to prolonged exposure to high concentrations of chromium vapour or dust may be irreversible and the treatment palliative. The risk of late development of cancer must not be ignored. It is important to consider chromium exposure as a possible cause in patients with chronic inflammation of skin and mucous membranes.

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