

Nasal Septal Perforations - An Occupational Hazard in Chrome Industry Workers

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Abstract: Persons working in nickel refineries, arsenic smelters and chrome plating factories are exposed to chromium compounds. Hexavalent chromium has been implicated for its toxic effects on the nasal mucosa. Detailed data of 108 workers, dealing in manufacturing of Chrome and its compounds, was collected concerning age, occupational history and clinical examination. Of the 108 cases, 52 cases had nasal and conjunctival irritation and 19 patients suffered from anosmia. All the workers had perforations involving anterior and middle portion of cartilaginous septum. However, no destruction of bony septum was observed. The current study concludes that ENT surgeons must enquire about the occupation of the patient in cases of septal perforations.

Keywords: Chromium, septal perforation

1. Introduction

Nasal septal perforation is a clinical condition which is attributable to local trauma (which may be iatrogenic), cocaine sniffing, and granulomatous diseases like Wegeners' granulomatosis[1]. It has been reported following intranasal steroid therapy as well[2-4]. Moreover, prolonged exposure to chromium compounds has been accountable for effects like ulcerated nasal mucosa, perforated nasal septum, epistaxis, irritant conjunctivitis, dermatitis and skin ulcerations. Ulceration and perforation in chrome platers is known since 1902[5]. while exposure to mercury fulminate, arsenic and cement may also contribute to ulceration and perforation[6]. Chromium (Cr) is a transition element occurring in nature, primarily in the elemental, trivalent (Cr (III)), and hexavalent (Cr (VI)) oxidation states. Both Cr (III) and Cr (VI) are environmentally stable, and their toxicologic profiles are well known. However, Cr (III) has limited toxicologic properties,[7,8] and is regarded as vital trace metal in humans,[9] while various Cr(VI) compounds are believed to be carcinogens and induce both acute and chronic toxic effects[10]. Exposure to hexavalent form of chromium is responsible for its toxicity and carcinogenicity[11.] Various studies have shown that hexavalent chromium has nephrotoxicity,neurotoxicity,reproductive toxicity,genotoxicity and induces Type II hypersensitivity reaction[12].Vasant et al, [13]have shown that apoptosis is the mode of cell death of human lymphocytes in the presence of both Cr (V) and Cr (VI). The respiratory tract is the major target organ of Cr (VI) toxicity. Acute exposure induces nasal membrane inflammation[11],coughing, and wheezing,[14] while persistent exposure contributes to ulcerations and perforations of the nasal septum, chronic bronchitis, decreased pulmonary function, pneumonia, and other respiratory effects[15]. Many neural defects, malformation and fetal deaths have been caused by Cr (VI)[16].

The aim of our study was to investigate nasal manifestations in chrome plating workers due to prolonged exposure to chromium compounds.

2. Material and Methods

A retrospective study was carried out on 108 workers from one single factory dealing in manufacturing of Chrome and its compounds during their annual health checkups at the local clinic from 1992-1994. A detailed data was collected regarding age, occupational history and clinical examination.

3. Results

Table 1: Age distribution and size of septal perforation

Age of patient in years	No of patients * n=108	Size < 5mm	Size 6-10 mm	Size 11-15mm	Size more than 15mm
25-30	11	01	02	01	02
31-35	18	01	03	04	01
36-40	21	01	04	05	0
41-45	34	02	04	07	05
46-50	24	0	04	02	01

A total of 108 chromium factory workers aged between 25-50 years, with a duration of exposure ranging from one to twenty years were examined during the study period. The main symptoms were drying and crusting of the nasal mucosa. Of the 108 cases, 52 cases had nasal and conjunctival irritation and 19 patients suffered from anosmia. Nasal examination was achieved through head mirror, Bulls' lamp and nasal speculum. All the workers had perforations involving anterior and middle portion of cartilaginous septum. However, no destruction of bony septum was observed. The size of perforations were measured using paper ruler through one nostril and viewing through opposite nostril .The perforations were divided into

four size ranges: a) less than 5 mm, b) 6-10 mm, c) 11-15 mm, d) more than 15mm. The age distribution and the size of septal perforations are depicted in the Table 1.

Of the 108 cases, fifteen and nineteen patients were suffering from atrophy of nasal mucosa and chronic irritant pharyngitis, respectively. All the cases were treated with regular alkaline nasal douching. This was followed by instillation of saline solution into the nose and subsequent application of Vaseline on both sides of the septum. Liquid paraffin nasal drops were also suggested to prevent crusting. Supportive multivitamin and antioxidant therapy was also given to all the cases.

4. Discussion

Chromium is a fragile metal which is usually extracted from ferruginous chromate. The toxic effects of prolonged exposure to chromium are well known in occupational medicine literature[7,8]. The mucosa covering Little's area is relatively vascular and closely adherent to underlying cartilage. The development of ulceration and perforation is considered to be due to the inhalation of hexavalent chromic acid mist. The mist causes inflammation and erosion/ulceration of nasal septum giving rise to rhinorrhoea and epistaxis. If exposure is limited, the ulcer heals imparting a permanent scar which is asymptomatic. However, some workers with perforations may be asymptomatic and ignorant of the 'hole' in their noses.

In a similar study of 28 workers of a chromium plating plant, having septal perforations, the symptoms of dryness, crusting, bleeding, wheezing and anosmia have been reported by Aiyer and Gaurav Kumar[17]. All the perforations involved only the cartilaginous part of the septum. The majority of cases had moderate and large perforations.

The progression of ulcers and perforations depends on the duration and intensity of exposure to chromium compounds. The time interval from first exposure to the development of ulceration and perforation in chrome platers varies between 6-12 months, while ulcers have also been reported after only a few days of plating work[6]. The earliest reported time interval between exposure and perforation is just a few weeks[18]. Six such cases were reported in the current study, this could be attributed to habit of workers resorting to nasal picking with contaminated fingers[19]. Low hygiene standards and nose picking have been described as widespread within the industry possibly due to the irritant nature of the hexavalent chromic acid mist. High standards of personnel hygiene and good environmental control of chromic acid mist is necessary to prevent nasal lesions[20]. Currently, there is not sufficient information in literature to recommend guidelines about the levels of chromium in whole blood, plasma and urine – total chromium or Cr (VI) below which current Cr (VI) exposure may be considered as safe or hazardous[21].

The caustic effect of chromium may lead to delayed wound healing as seen on nasal septum which may eventually perforate. Prevention can be achieved by proper exhaust ventilation and regular vacuum cleaning of the shop floor. Personal hygiene practices such as wearing of dust masks and hand washing thoroughly at the end of work ultimately prevents development of septal perforations. An ointment containing 10 % CaNO₃ and EDTA applied regularly to the septum before exposure, could assist in maintaining the septal integrity. EDTA reduces hexavalent chromium to trivalent form

which has less irritant and corrosive action. An alternative is "plater's ointment, a combination of lanolin and soft paraffin applied directly to nasal passages to prevent inflammation and ulceration[22]. The study concludes that ENT surgeons must enquire about the occupation of the patients presenting with septal perforations. Variation of the size of the perforation and its correlation with the duration of exposure requires further detailed study with a large number of workers.

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References

- [1] Miles Foxen EH. Lecture Notes on Diseases of the Ear, Nose and Throat. London, UK: Blackwell, 1980
- [2] Schoelzel EP, Menzel A, Soderberg-Warner ML. "Nasal sprays and perforation of the nasal septum [letter]". JAMA, 12;253(14):2046, 1985.
- [3] Soderberg-Warner ML. "Nasal septal perforation associated with topical corticosteroid therapy". J Paediatr, 105(5):840-1, 1984.
- [4] Isaksson M, Bruze M, Wihl J. "Contact allergy to budesonide and perforation of the nasal septum". Contact Derm, 37: 133, 1997.
- [5] Legge TM, Oliver T, Dangerous Trades. London, UK, Murray, 447, 1902.
- [6] Hunter D. Diseases of Occupations. First Edition. English Universities Press Ltd, 1965.
- [7] De Flora S, Bagnasco M, Serra D, Zancchi P. "Genotoxicity of chromium compounds A review", Mutat Res, 238:99-172. 1990.
- [8] IARC (International Agency for Research on Cancer). Chromium, Nickel and Welding. IARC Monogr Eval Carcinog Risk Hum 49:1-677. 1990.
- [9] Anderson RA. Nutritional role of chromium. Sci Tot Environ 17:13-29, 1981.
- [10] ATSDR. Final Report of Toxicological Profile for Chromium. NTIS Accession No. PB2000-108022. Atlanta, GA: Agency for Toxic substances and Disease Registry, 2000.
- [11] Sudha P.N. "Are we eating chrome chicken?????" The Socioscan, Vol 2(3&4) pp 69-71, 2010.
- [12] Xinggang Wang. "Correlation analysis between incidence of chromium-induced nasal diseases and working environment" Journal of Chinese Clinical Medicine, 4(6):325-328, 2009
- [13] Vasant C, Balamurugan K, Rajaram R, Ramasami T. "Apoptosis of lymphocytes in the presence of Cr (V) complexes: Role in Cr (VI)-induced toxicity." Biochem Biophys Res Commun, 285:1354-60, 2001.
- [14] Sobaszek A, Boulenguez C, Frimat P, Robin H, Haguenoer JM, Edme JL. "Acute respiratory effects of exposure to stainless steel and mild steel welding fumes". J Occup Environ Med, 42:923-931, 2000.
- [15] Bradshaw LM, Fishwick D, Slater T, Pearce N. 1998. "Chronic bronchitis, work related respiratory symptoms, and pulmonary function in welders in New Zealand". Occup Environ Med, 55:150-154, 1998

- [16] Ray S, Ray MK. "Bioremediation Of Heavy Metal Toxicity-With Special Reference To Chromium". *Alme en J Med Sci* 2(2) Special:57-63, 2009.
- [17] Aiyer RG, Gaurav Kumar. "Nasal manifestations in chromium industry workers". *Indian J Otolaryngol Head Neck Surg* Vol 55 No.22 pp 71-73, 2003.
- [18] Zimmerman HJ, Konietzko H, Apel H. "Nasal septum perforations in workers in a plating plant". *Zbl Arbeitsmed*, 36: 65-67, 1986.
- [19] Williams N. "What are the causes of a perforated nasal septum?" *Occup. Med* Vol. 50, 135-136, 2000.
- [20] Cohen SR, Davis DM, Kramkowski PE. "Clinical manifestations of chromic acid toxicity: nasal lesions in electroplate workers". *Cutis* 13: 558-568, 1974.
- [21] Guidotti TL, McNamara J, Moses MS. "The interpretation of trace elements analysis in body fluids" *Indian J Med Res*; 128:524-532, 2008.
- [22] Williams N. "A Survey of respiratory and dermatological disease in the chrome plating industry in the West Midlands, UK.", *Occup. Med.* Vol. 46(6), 432-434, 1996.

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Publications –

Naik MS, Naik SM, Bains NK. Ear Piercings Revisited. *Online J Otolaryngol*. 2013; 3(4): 113-119

Naik SM, Naik MS, Bains NK. Citation Styles – An analysis. *Online J Otolaryngol*. 2013; 3(3): 52-56

Naik SM, Naik MS, Sharma A. "Rehabilitation of hearing impaired children in India – An update". *Online J Otolaryngol*. 2012; 23(1): 20-31

Naik MS, Naik SM, Mohanty D. Recurrent osteoma of the frontoethmoid region- A case report. *Odisha Journal of Otorhinolaryngology & Head & Neck Surgery*. 2012 Jan-Jun; 6(1): 55-57.

Naik SM, Naik MS, Datta G, Sharma C, Singh D. Adenoids in adult siblings : Is it familial ?. *Online J Otolaryngol*. (2012), 2(4): 4-9.

Naik MS, Naik SM. Whitehead's varnish - an alternative to BIPP pack. *Online J Otolaryngol*. 2012, 2(2).

Naik MS, Naik SM. Medicolegal status of deaf persons in India. *Online J Otolaryngol*. (2012), 2(1): 19-38.

Naik MS, Naik SM. An Unusual Presentation of Nasal Polyp Arising from Floor of Nasal Cavity. *Otorhinolaryngology Clinics An International Journal*. (2011); 3(2): 129-131

Juvekar RV, Mishra SC, Naik S, Ogale SB, Prasad D, Thirugnanam R, et al. Sparfloxacin in the treatment of purulent sinusitis—a multicentric study in Indian patients. *Indian J Otolaryngol Head Neck Surg*. (1999) January; 51(1): 80–83

Maroli S, Brado R, Shahani S, Tripathi R, Kukereja V, Naik S, et al. Evaluation of efficacy of dispersible cetirizine with standard cetirizine preparation in allergic rhinitis. *The Indian Practitioner* (1997) 50(10): 851-856



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Naik MS, Naik SM, Bains NK. Ear Piercings Revisited. *Online J Otolaryngol*. 2013; 3(4): 113-119

Naik SM, Naik MS, Bains NK. Citation Styles – An analysis. *Online J Otolaryngol*. 2013; 3(3): 52-56.

Naik SM, Naik MS, Sharma A. "Rehabilitation of hearing impaired children in India – An update". *Online Journal of Otolaryngology*. 2012; 2(4)

Naik MS, Naik SM, Mohanty D. Recurrent osteoma of the frontoethmoid region- A case report. *Odisha Journal of Otorhinolaryngology & Head & Neck Surgery*. 2012 Jan-Jun; 6(1): 55-57.

Naik SM, Naik MS, Datta G, Sharma C, Singh D. Adenoids in adult siblings : Is it familial ?. *Online J Otolaryngol*. (2012), 2(4): 4-9.

Naik MS, Naik SM. Whitehead's varnish - an alternative to BIPP pack. *Online J Otolaryngol*. (2012), 2(2).

Naik MS, Naik SM. Medicolegal status of deaf persons in India. *Online J Otolaryngol*. (2012), 2(1): 19-38.

Naik MS, Naik SM. An Unusual Presentation of Nasal Polyp Arising from Floor of Nasal Cavity. *Otorhinolaryngology Clinics An International Journal*. (2011); 3(2): 129-131